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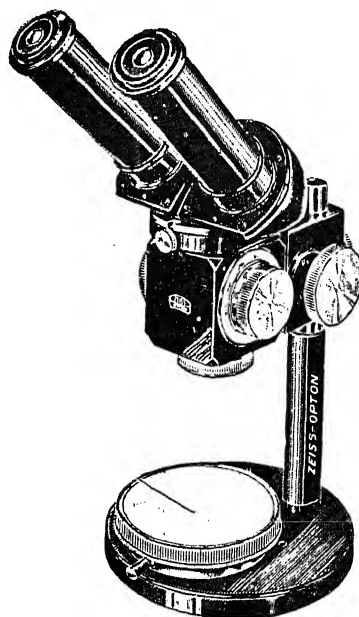
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THE LUMINESCENCE OF DIAMOND—II

SIR C. V. RAMAN

1. LUMINESCENCE AND CRYSTAL STRUCTURE

THE spectral character of the visible luminescence excited in diamond by irradiation with long-wave ultra-violet light was described and illustrated in an earlier article of this series, and the remarkable diversity of behaviour displayed by different specimens of diamond in these circumstances was duly stressed. Why this should be so is a problem which might well have remained unsolved, had it been an isolated issue. At our early stage of the Bangalore investigations, however, it became apparent that luminescence was only one of a whole group of physical properties of diamond which exhibit large variations, and that these are interrelated with each other. A detailed study of the situation was made possible by the circumstance that the collection of material included a large number of polished cleavage plates of diamond—a form which is exceptionally well-suited for such investiga-

tions. It will suffice here to mention four series of studies made with these plates which covered the following topics: (a) the absorption in diamond of ultra-violet radiation of wave-lengths between $\lambda 2000$ and $\lambda 3000$; (b) the absorption of infra-red radiation of wave-lengths between 6μ and 12μ ; (c) its structural birefringence; and (d) the intensity of X-ray reflections by the lattice planes of the crystal.

That physical properties so different in their nature as those stated above exhibit variations correlated with each other and with luminescence is by itself an indication that a common cause underlies all the variations. Of particular importance in this connection was the discovery that a good many of the plates exhibited luminescence of varying colour and intensity over their area, showing geometric patterns with a configuration related to the structure of

the crystal. This suggested investigations by appropriate methods of the other properties listed above, and the result emerged that the cleavage plates which showed geometric patterns of luminescence also exhibited patterns of ultra-violet transparency, patterns of infra-red transmission, patterns of structural birefringence and patterns of X-ray reflection intensity; the geometric features of all these patterns bore a recognizable relationship with each other. The evidence for the structural origin of the whole group of effects was thereby greatly strengthened.

It is proposed in this article to present the experimental facts briefly summarised above,

diamond. The technique of photographing their patterns so as to exhibit the relationship between them has recently been greatly improved, and a whole series of new photographs by Mr. A. Jayaraman were reproduced with a paper which appeared in the *Proceedings* of the Indian Academy of Sciences for August 1950. Other photographs taken with the same apparatus illustrate the present article (Figs. 1 and 6 below).

2. THE LUMINESCENCE PATTERNS

In order to observe or photograph its luminescence, the diamond is placed on a piece of black glass and irradiated by a beam of sunlight filtered through a plate of Wood's glass and

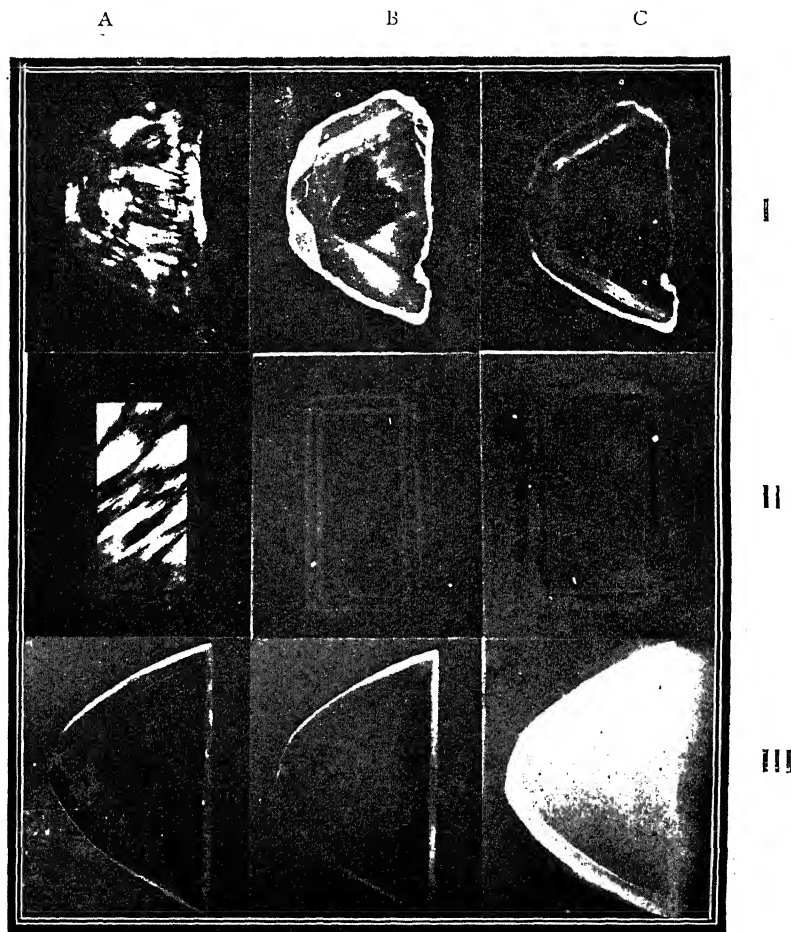


FIG. 1

Luminescence and Birefringence Patterns of Three Representative Diamonds.

(A) Birefringence, (B) Green Luminescence and (C) Blue Luminescence.

in somewhat greater detail. Of particular significance and importance is the relationship between luminescence and birefringence in

focussed on the specimen. Viewing the diamond through a blue filter, one isolates the part of the luminescence which arises from the

electronic transition at $\lambda 4152$ and its associated vibrational transitions. Similarly, viewing the diamond through a filter which has a cut-off for wave-lengths shorter than $\lambda 5400$, the blue part of the luminescence is extinguished, while the luminescence arising from the electronic line at $\lambda 5036$ and its associated vibrational transitions can be seen, though with considerably reduced intensity.

have a group which exhibits "blue" luminescence. This is more or less perfectly uniform in intensity over the area of the plate, while observations through the appropriate filter show the "green" luminescence to be either weak or wholly absent. *Secondly*, we have a group which exhibits neither the blue nor the green luminescence with observable intensity. Such diamonds may, therefore, be classed as *non-*

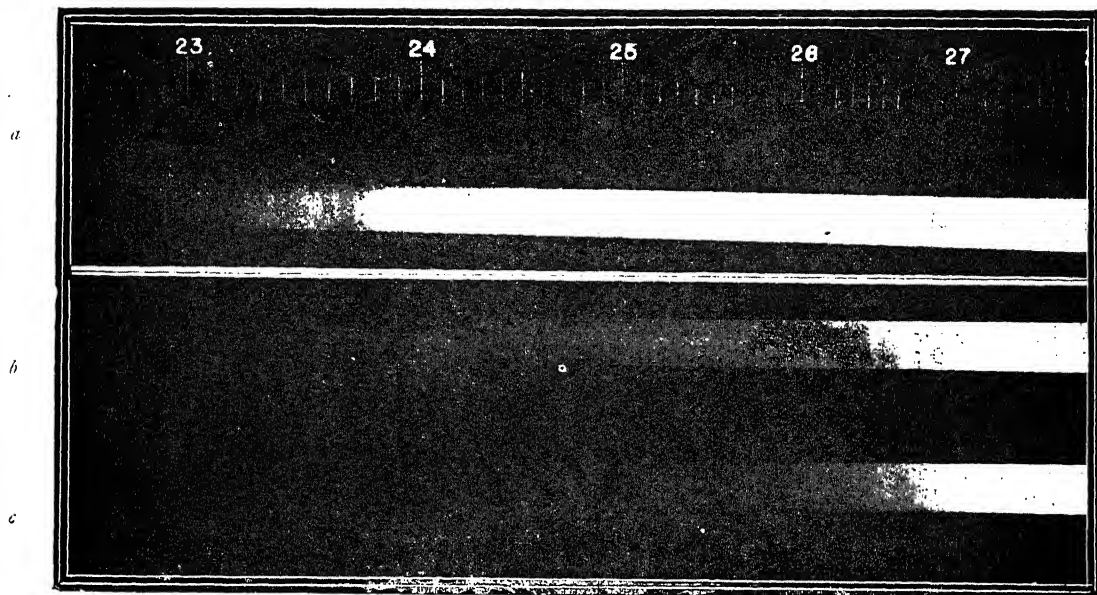


FIG. 2

Ultra-Violet Absorption in Blue-Fluorescent Diamond of different thicknesses.

(a) 0.15 mm., (b) 0.30 mm. and (c) 0.37 mm.

(After K. G. Ramanathan)

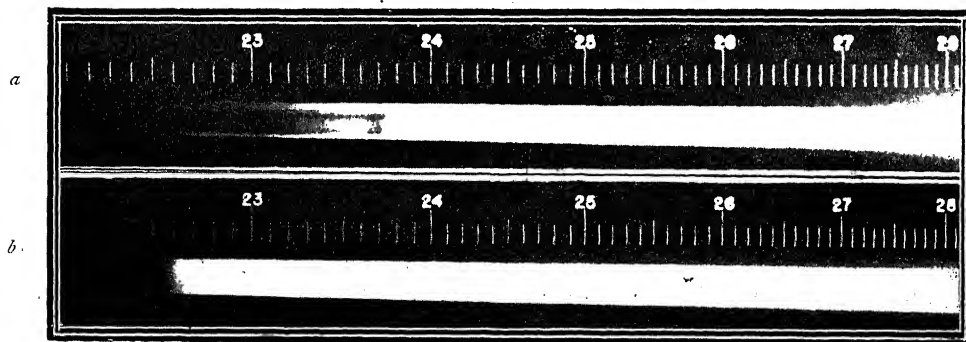


FIG. 3

Ultra-Violet Absorption in (a) Green-Fluorescent Diamond and (b) Non-Fluorescent Diamond.

(After K. G. Ramanathan)

Over a hundred cleavage plates of diamond included in the Bangalore collection have been studied in the manner described. They are found to fall into three groups. *Firstly*, we

fluorescent. *Thirdly*, we have a group comprising the majority of our specimens. These exhibit geometric luminescence patterns, the nature of which varies greatly from specimen

to specimen. In some diamonds, part of the area is non-fluorescent while the rest exhibits the "blue" luminescence usually accompanied by a weak green luminescence, as shown by observation through the filter. There are, however, many specimens in which the presence of both types of luminescence is evident even without the aid of the filter. Viewed through the filter which cuts out the blue luminescence, the "green" luminescence becomes apparent as parallel bands of a greenish-yellow colour traversing the plate in different directions. The assistance of the filter enables such bands to be detected in areas which show only blue luminescence without such aid.

We may summarise the position by the statement that some diamonds are non-luminescent, others exhibit only blue luminescence, while a third class exhibits a more complex behaviour in which the appearance of both the blue and green types of luminescence with varying relative intensities is a characteristic feature. The facts observed suggest that this third category of specimens may be described as being a "mixture" of the first two kinds of diamond, namely, the non-fluorescent and blue-fluorescent ones. Their juxtaposition is evident in

3. PATTERNS OF ULTRA-VIOLET TRANSPARENCY

A simple technique was developed for the study of the transparency of cleavage plates of diamond to the ultra-violet radiations of the mercury arc in quartz. The most intense part, viz., the resonance radiation of wave-length $\lambda 2537$ is separated from the rest by the use of a dispersing assembly composed of a quartz prism and a pair of quartz lenses. The radiation thus isolated falls on the cleavage plate of diamond which is held attached to a thin sheet of canary-yellow or uranium glass. The fluorescence excited in the latter in the parts screened by the diamond reveals whether any of the incident radiation is transmitted by the latter. The parts that are opaque to the radiation appear dark in the fluorescent glass. Those that are transparent show the full intensity, while partial transparency is indicated by a diminished brightness of fluorescence.

Observations made by this technique reveal the correlation which exists between the ultra-violet transparency of a diamond to the $\lambda 2537$ radiation and the luminescence excited in it by ultra-violet radiation of much greater wavelengths. Non-fluorescent diamonds are completely transparent to the $\lambda 2537$ radiation.

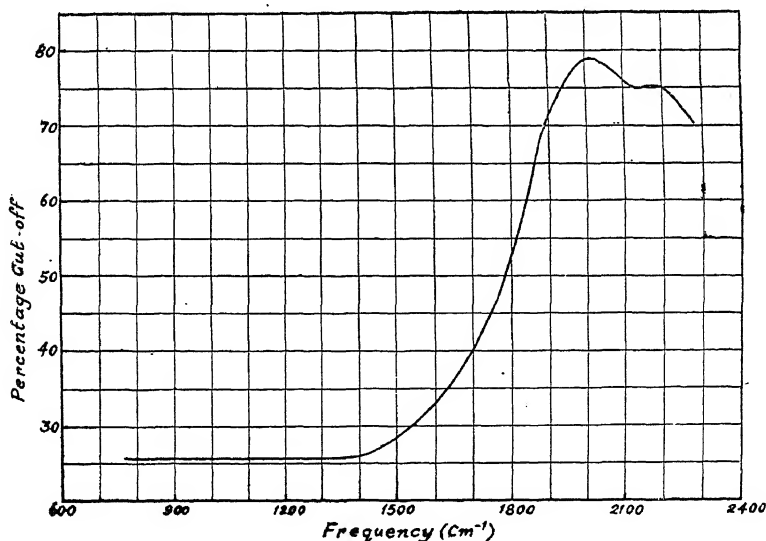


FIG. 4

Infra-Red Transmission by Non-Fluorescent Diamond.

some specimens on a simple inspection of their luminescence patterns. In other specimens, especially those showing the green luminescence prominently, the mixture appears to be on a finer scale.

Diamonds which fluoresce blue with weak or moderate intensity are opaque to the same radiation. "Mixed" diamonds which are in part non-luminescent and in part blue-luminescent show these parts as respectively transparent and

opaque to the $\lambda 2537$ radiation. The diamonds which are green-fluorescent exhibit a marked transmission, which is however distinctly inferior to that of non-fluorescent diamond. Strongly blue-luminescent diamonds show a weak but nevertheless observable transmission of the $\lambda 2537$ radiation.

It is obvious that the terms transparency and opacity used above can have a precise meaning only if the thickness of the plate and its percentage of transmission are specified. The investigations made reveal that while all diamonds show a complete cut-off for wavelengths less than $\lambda 2250$, it is possible by reducing the thickness sufficiently to observe a transmission down to that limit even in the case of diamonds which in thick layers are opaque beyond $\lambda 3000$. This effect is illustrated in Fig. 2 for a diamond of the blue luminescent type.

diamonds irrespective of their behaviour in luminescence show an absorption in the infra-red region between 7μ and 4μ . This is a second-order absorption due to the octaves and combinations of the characteristic frequencies of the crystal lattice.

5. PATTERNS OF STRUCTURAL BIREFRINGENCE

We are not here concerned with the accidental birefringence due to visible flaws or inclusions in diamond, but will consider only the birefringence having a structural origin observed in plates which appear otherwise faultless. The effect, if present, is readily observed when the plate is held between crossed polaroids and viewed against a bright source of light. Since the optical effects arising from a local stress extend far beyond the point of its application, while, on the other hand, luminescence is an essentially localised phenomenon, we cannot expect a perfect correspondence between the

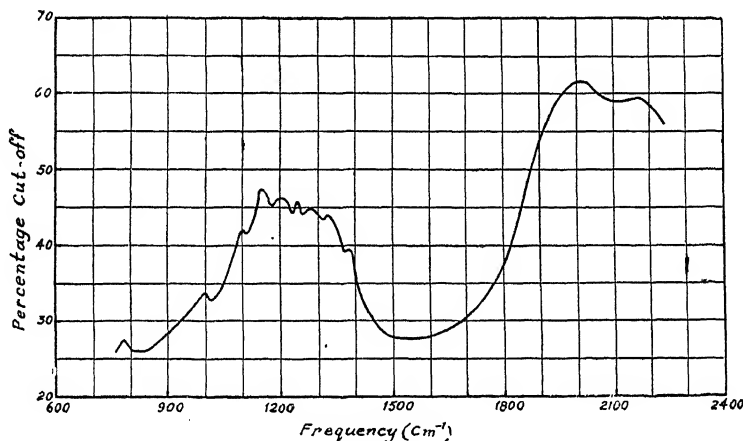


FIG. 5

Infra-Red Transmission by Green Fluorescent Diamond

4. PATTERNS OF INFRA-RED TRANSMISSION

Investigations reveal a precise correlation between the transparency of diamond to infra-red radiation in the 8μ region of wave-length and its behaviour in respect of luminescence. When appropriate corrections are made for reflection at their surfaces, non-luminescent diamonds are found to be completely transparent to infra-red radiation of wave-length 8μ , while diamonds which are blue-fluorescent with weak or moderate intensity show a strong absorption in that region. The absorption is, however, distinctly less for diamonds which exhibit an intense blue luminescence. Diamonds which exhibit a green luminescence have only a weak absorption in the 8μ region and indeed approach the non-fluorescent diamonds in their behaviour. It should be remarked that all

luminescence and birefringence patterns. Nevertheless, the effects observed, especially in plates of small thickness, are sufficiently striking to carry conviction. The numerous specimens available for the study enable a complete correlation to be established.

The diamond plates in the collection may be divided into three categories. *Firstly*, we have a group which exhibits little or no birefringence and makes a near approach to the perfect optical isotropy to be expected in a cubic crystal. Such diamonds invariably exhibit "blue" luminescence, its intensity being more or less perfectly uniform over the area of the specimen. *Secondly*, we have a group of diamonds which exhibit a characteristic type of lamellar birefringence: fine streaks are seen running parallel to the octahedral of the

dodecahedral planes of the crystal, the alternate layers exhibiting positive and negative birefringence as determined with the aid of a Babinet compensator. Diamonds which exhibit

the area of the plate. The presence of such bands in birefringence goes hand in hand with the appearance of green or greenish-yellow bands of luminescence as already described.

C

B

A

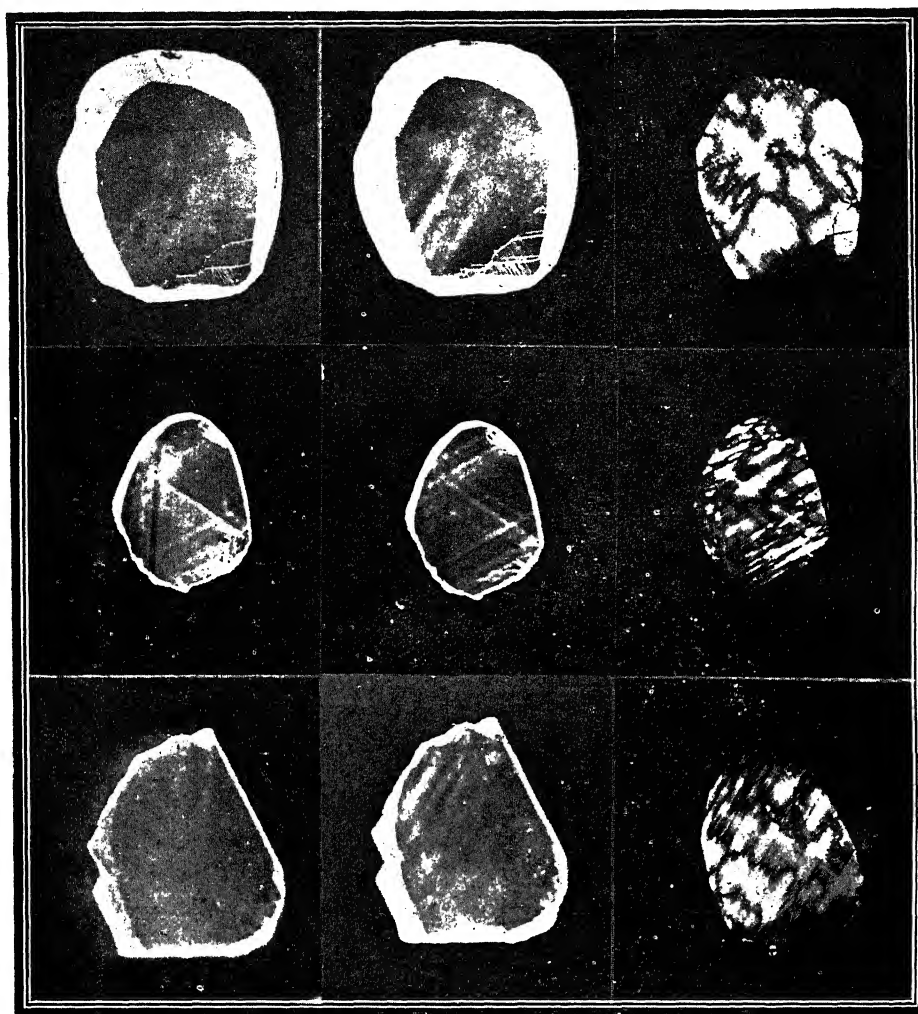


FIG. 6

Luminescence and Birefringence Patterns.

(A) Birefringence, (B) Green Luminescence and (C) Blue Luminescence.

this type of birefringence over their entire area are invariably *non-luminescent*. *Thirdly*, we have a group of diamonds in which the birefringence is a more complex character, varying from specimen to specimen. In some specimens, extensive areas are observed where the birefringence is of the type characteristic of non-fluorescent diamonds, while in other areas the birefringence is weak or absent as in the case of "blue" luminescent diamonds. More common are the specimens in which broad bands of birefringence run parallel to each other over

Figs. 1 and 6 above have been reproduced from photographs taken recently by Mr. A. Jayaraman and illustrate the foregoing remarks. The three photographs marked III in Fig. 1 illustrate a typical case of a blue-fluorescent diamond exhibiting no birefringence and no green luminescence. The three pictures marked II in the same figure represents a typical non-fluorescent diamond giving neither blue nor green luminescence but exhibiting a streaky birefringence. The three pictures marked I in the figure are photographs of a diamond which

exhibits both green and blue bands of luminescence over a greater part of the area, but has a central area which is non-fluorescent. The birefringence of the plate exhibits a banded structure having a recognisable relationship to the features observed in luminescence. This is better seen in Fig. 6 which reproduces the patterns of blue and green luminescence and birefringence of three typical diamonds of the third or mixed category. In Fig. 6 (I), the striking feature is the appearance of broad bands of yellow luminescence traversing the crystal. These run parallel to the broad bands of birefringence seen cutting across numerous fine streaks of the kind seen in non-luminescent diamond which appear in a different direction. A careful study of Figs. 6 (II) and 6 (III) will repay the reader for his trouble. They form excellent illustrations of the relations between luminescence and birefringence described in the foregoing pages.

6. PATTERNS OF X-RAY REFLECTION INTENSITY

The method of recording these patterns—also called X-ray topographs—is in principle simple and has been described in detail in the papers by Dr. G. N. Ramachandran on the subject. It makes use of white X-rays diverging from a pin hole to obtain the Laue reflections

from the full area of the cleavage plate. The reflections recorded may be either from the internal or the surface crystallographic planes, the technique necessary to obtain a undistorted picture of the crystal being different in two cases. Clear photographs can only be obtained with relatively thin plates.

The features observed in the X-ray topographs are very revealing. It is found that the weakly-blue luminescent areas make a near approach to the ideally perfect crystal structure and give the weakest Laue reflections. A greater intensity of blue luminescence results in a corresponding increase in the intensity of X-ray reflection. On the other hand, areas which are non-luminescent give extremely intense X-ray reflections. The reason for this is presumably the lamellar structure of the diamond which is evident also in the birefringence. It is found that the bands of greenish-yellow luminescence crossing the areas of blue luminescence are represented in the X-ray topographs by very bright streaks. This observation supports the inference that the "green" luminescence is a consequence of the admixture on a fine scale of the blue-luminescent and the non-luminescent types of diamond.

(To be continued)

INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES

AN International Conference on Elementary Particles was organized by the Tata Institute of Fundamental Research, Bombay, from the 15th to 22nd December 1950. This is the first time that a conference of this type on such a high scientific level has been held in India. This was made possible by grants from various official and non-official organisations in India and abroad and specially, by a substantial subvention from the UNESCO, which enabled a number of distinguished scientists from abroad to attend the conference.

Studies on both experimental and theoretical aspects of the subject were discussed at the conference. The theoreticians were mainly interested in the fundamentals of quantum mechanics. For instance, Rosenfeld spoke on ideas of measurability developed by Bohr and himself, Peierls spoke on commutation laws in relativistic quantum theory, Perrin on spinors and Moller on non-localised quantum field theories. Discussions on the theory of elementary particles themselves were led by Bhabha who presented the relativistic theory in the latest form developed by him. Other papers were by Heitler on the production of mesons, Fermi on nuclear stars, Wentzel on nuclear reactions involving mesons, Eliezer on the equa-

tion for the electron and Majumdar on the radiative scattering of the electron.

Cosmic rays are still the main source of high energy particles for most of the experimenters although some studies have also been made with particles from powerful cyclotrons. The papers presented could broadly be classified into four types: (a) those dealing with the influence of factors like latitude and meteorological conditions on the intensity of cosmic rays; (b) those concerning the interaction of cosmic rays with atomic nuclei; (c) those aiming at discovering the primary constituents of cosmic rays; and (d) those describing the experimental techniques. In addition, Blackett presented some recent work on V-mesons discovered by his group, and showed photographs of their tracks in a cloud chamber.

Reviewing the present knowledge on cosmic rays, Saha concluded that they were probably galactic in origin, while Blackett was of the view that they need not necessarily be produced by nuclear reactions and that a mechanism analogous to the one which causes thunderstorms could well be responsible for the production of these high energies, as has been suggested by Fermi.

THE PRESENT CONCEPT OF THE PHYSICAL WORLD*

WITH a few notable exceptions, scientific activity in the modern sense did not begin till the Italian renaissance. It was Leonardo da Vinci who wrote in one of his manuscripts, "There is no certainty where one can neither apply any of the mathematical sciences nor any of those which are based on the mathematical sciences", and it expresses the new spirit of the times, a spirit which was to lead eventually to that vast development, which is modern science and technology. What Leonardo wished to emphasize, was that as long as an observation of a natural phenomenon remained couched in qualitative terms it would not be definite enough to build on, and only by introducing accurate measurement and quantitative relations into it could one be certain that it was right or wrong within the limits of accuracy of the measurements. Once this general approach received fairly wide acceptance, the development of science in the modern sense was inevitable.

It was found quite soon that certain properties, which could be stated in terms of exact measurement, were common to many objects. In certain cases, therefore, it became possible to state general laws without specifying the particular object to which it applied. In order to connect up such laws of nature with each other it may be necessary to formulate certain more abstract principles or postulates from which the various observed regularities can be deduced. Newton's fundamental laws of motion exemplify this approach. For instance, one might imagine his first law to be a statement arrived at from direct observation through some process of induction, *viz.*, that if we could take a body into space to a very great distance from all other material bodies, then it would either remain at rest or move in uniform motion in a straight line. We know today that such an induction cannot be made, and may indeed not even be true for the actual world. This analysis shows us that strictly speaking Newton's laws of motion and gravitation are abstract mathematical statements which he quite rightly calls axioms. And if they came to be regarded as objectively true it is because the behaviour of objects which could be deduced from them by mathematical reasoning agreed with our direct observations.

We turn now to review the development of our picture of the physical world resulting

from recent discoveries. Round about 1930, the picture appeared to be remarkably simple. The whole material world was thought of as made up of just two types of elementary particles, protons and electrons. Light, or in more general terms, electro-magnetic radiation, or photons, and gravitation, were the only two other physical entities found in nature. A scientist at that time could have thought, as many did think, that when one knew the mathematical laws governing the behaviour of these four elementary types of physical entities, one would know everything of a fundamental nature that there was to know of the physical world. The subsequent development of the last twenty years shows us how far this belief was from the truth. It shows in a striking manner that however great the successes of a theory, unless this success is complete and total, it is always possible that something very important may have slipped through the net. The apparently small but persistent difficulties or inconsistencies in a theory, or small discrepancies between theory and observation, may be essentially unbridgeable within the framework of the basic concepts of that theory and yield the clue to new ideas.

Discrepancies of this sort were, in fact, present in the picture mentioned above. Experimental studies showed that all nuclei seemed to behave as if the electrons, which were supposed to be in them, only manifested their electric charge, but neither their spin nor their statistics, both of which depended only on the number of heavy particles present. A bold attempt to face this difficulty would soon have led one to the view that nuclei were not composed of protons and electrons but rather of protons and some hitherto unknown particle having the same mass as the proton, the same spin and satisfying the same statistics. A particle of this description was discovered by Chadwick in 1931 and was called a neutron. This discovery led to the acceptance of the picture that all nuclei are made up of only protons and neutrons. Since electrons are known to emerge out of radio-active nuclei, the concept of an elementary particle had to undergo a radical change, *viz.*, that while the elementary particles are not composite and that as long as they exist they are immutable, nevertheless there are occasions when one or more such particles can disappear altogether with the simultaneous creation of another set.

In 1931, Anderson discovered the positron. The existence of this new particle could be understood immediately in terms of an equa-

* Summary of the Address given by the General President, Dr. H. J. Bhabha, to the Thirty-Eighth Session of the Indian Science Congress, held at Bangalore.

tion for the electron put forward by Dirac in 1928. Nevertheless, a consequence of this theory was that no electron or photon of even the highest energy could penetrate large amounts of matter, while a growing body of evidence from cosmic ray experiments indicated that particles which looked like electrons did in fact penetrate great thicknesses of matter. Thus, there seemed to be evidence that quantum theory failed for very high energy electrons, while at the same time there was no theory to explain the phenomenon of the cosmic ray showers. It was only when the Cascade Theory put forward by Heitler and the present author showed that the existence of cosmic ray showers and the behaviour of the soft component of cosmic rays in the atmosphere and in dense substances could be explained on the basis of quantum theory was it possible to conclude that the electron-like tracks of particles, which did not behave completely like electrons nor like protons, must be due to a new type of particle having an intermediate mass. Thus, the existence of a new particle called the meson, with a mass some 204 times that of the electron came to be established in 1938.

Since then, many types of mesons have been discovered, and we know now that at least nine different types of elementary physical entities exist in nature, while the existence of two more is almost certain. While experiments

may give us information about the masses of these particles, their mutual interactions and the processes in which they take part, it seems inconceivable that an experiment would enable us to deduce directly the mathematical equation describing the behaviour of any such particle. We can only hope to set up such equations by taking as our guides certain well-known principles, as for example the principle of relativity and the ideas underlying quantum mechanics.

It is clear that we are now penetrating into a new level of nature which was practically unknown some twenty years ago. The circumstance that there are a dozen different types of elementary particles in nature would lead us to expect that there may be many more, and indeed with our present knowledge we cannot exclude the possibility that there may be an infinite number of them. This does not mean, however, that we shall never be able to obtain a complete description of them all. It is quite possible that with increasing knowledge we may be able to find the formula which gives us the masses of all the elementary particles and the general principles which will allow us to deduce the equation satisfied by a particle of any particular mass. If this were not so, we would be faced with a situation in which we could never hope to give an exhaustive description of everything there is in nature, but only to extend with the flow of time the region which we had explored and understood.

WORLD-WIDE QUEST FOR URANIUM

THE quest for uranium during the last decade has been ever on the increase and has transformed the metal from a scientific curiosity to one of strategic importance. The realisation that the availability of uranium in the earth's crust is limited and capriciously distributed has restricted its use to mainly military purposes. To aid a world-wide search for uranium, the Governments of various countries are giving active help and encouragement. The results of governmental action have been remarkable. New types of radiation detection instruments to speed up the work of exploration have been evolved; several new discoveries of uranium minerals and ores of potential significance have been reported from Belgium, Congo, U.S.A., Canada and Australia; new processes are being developed for more effective recovery of uranium from low-grade materials.

The British Government, like the others, have published two booklets, with a view to stimulate uranium production, which are reviewed by the timely Information Bulletin.*

The booklets deal with the nature of occurrence of uranium minerals, the techniques used to detect them and the methods of analysis including details of procedures evolved at the Chemical Research Laboratory at Teddington. These involve a minimum of laboratory equipment and chemicals and are ideally suited for prospecting expeditions. These booklets will be of invaluable help to prospectors.

The Government of India, through the Atomic Energy Commission, have announced recently their intention to give a filip to prospecting and to buy all uranium ores. It would be of considerable assistance to Indian prospectors, of whom there are many these days, if the Indian Atomic Energy Commission would publish a handbook detailing the nature of occurrence of uranium in India and the techniques of prospecting. It would go a long way to fill a real need, help the prospectors and thereby the Government of India.

N. R. SRINIVASAN.

* Information Bulletin issued by B.I.S., New Delhi,

THE INFLUENCE OF NON-GLYCERIDIC CONSTITUENTS ON AUTOXIDATIVE RANCIDITY OF SESAME OIL

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SESAME oil used in these experiments unless otherwise stated, was specially pressed from good quality seed in a local wooden ghany. Storage stability tests were done by exposing 0.5 gm. of the oil sample in each of a series of clean pyrex test tubes $5\frac{3}{4}'' \times \frac{3}{4}''$, selected for uniformity of diameter to diffuse daylight and examining two tubes every few days. The test tubes were plugged loosely by cotton wool. Peroxide values were determined by a modification of Wheeler's method described in detail by the authors in a recent paper.⁴ The smell was observed by two different workers and classified according to the classification used by John, McConnell and Esselen.⁵

EXPT. (1) EFFECT OF SUSPENDED MUCILAGINOUS MATTER

Stability test runs carried out on the settled unfiltered oil as well as on oil filtered through a hot water jacketed glass funnel showed that both samples were free from any rancid smell after a period of 57 days, but smelled blank. The peroxide value increased from 2.2 to 14 in the case of unfiltered oil and from 7.7 to 34.7 in the case of filtered oil. The former retained its original bright yellow colour, but the latter, which was lemon yellow at start, became lighter after 4 days and then progressively increased in colour to an orange red.

EXPT. (2) EFFECT OF THE CONSTITUENTS PRESENT IN THE HUSK

Sesame seed was freed from the husk by soaking in water for two days in the dark and rubbing same between two layers of rough cloth. Oil from the de-husked seed as well as from the un-dehusked seed was solvent extracted with petroleum ether (60-80° C.) and dried under vacuum. The former was much lighter in colour and had a less distinctive smell. Storage stability tests carried out on both samples showed that the P.V. of the oil from the un-decorticated seed increased from 2.2 to 9.6 in 39 days while the oil from the decorticated seed increased from 2.2 to 9.4. Both oils lost part of the colour, and the smell after 39 days was blank.

EXPT. (3) EFFECT OF REMOVAL OF SESAMIN

50 Grams of sesame oil dissolved in 50 c.c. petrol ether (60-80° C.) was extracted repeatedly (10 times) with 20 c.c. portions of 90 per cent. acetic acid by shaking in the cold, the acid

layer being separated each time. The petrol ether portion was washed free from acid, the solvent removed by distillation under vacuum and the oil dried. Storage stability tests were carried out on part of this oil which was expected to be comparatively free from sesamin.²

During a period of 41 days P.V. increased from 5.1 to 11.2 and the oil lost part of its colour. Organoleptically the sample smelled good at the start, became blank after 15 days and continued to be so till the end.

EXPT. (4) EFFECT OF REMOVAL OF SESAMIN AND SESAMOL

The oil free of sesamin (Expt. 3) was cold extracted by shaking it with equal quantities of alcohol repeatedly (12 times) to remove sesamol⁶ and any fatty acids. The oil freed of the solvent under vacuum was examined for storage stability with results as given in Table I.

TABLE I

Storage time in days	Peroxide values	Organoleptic condition	Appearance
0	12.9	Very good	Light yellow
6	25.7		
11	77.3	Blank	
15	175.3	Rancid	White, clear, transparent
18	262.0	"	" viscous
21	314.7	"	" "
24	439.4	"	" "
28	537.9	"	" "
33	724.6	"	" very viscous
38	729.5	"	" "

EXPT. (5) EFFECT OF TREATMENT OF SESAMIN- AND SESAMOL-FREE OIL WITH CALCINED ALUMINA

After the alcohol treatment in Expt. 4, the rest of the oil, which may now be expected to be free from sesamin and sesamol was taken up in petrol ether and shaken with an excess of specially prepared tested alumina with a view to remove any vitamins⁷ as also most of the residual colouring matter. The alumina was prepared by calcining pure aluminium hydroxide at 700° C. in an electric furnace for one hour. The oil, freed of the solvent and calcined alumina, was examined for storage sta-

bility. After 41 days, its peroxide value had gone up to only 29.1 from an initial value of 8.4. Organoleptically the oil smelled good at start and became blank after 41 days with no smell of rancidity. The colour, which was light yellow at start, became lighter after 15 days and was nearly bleached at the end.

EXPT. (6) EFFECT OF TREATMENT WITH BONE CHAR

The oil obtained in Expt. 5 after treatment with calcined alumina was treated in petroleum ether solution with bone charcoal for 6 hours, filtered, freed of the solvent and dried under vacuum. The oil which was very faintly yellow and free from odour was tested for storage stability as before with results as given below:

TABLE II

Storage time in days	0	6	11	15	18	21	24	28	33	38	41
Peroxide value	5.8	22.2	47.5	67.4	82.6	105	121	157	227	364	307

DISCUSSION

With the removal of sesamol by means of alcohol in Expt. 4 the oil shows marked deterioration in stability which confirms the findings of H. A. Mattil³ that sesamol has antioxidant properties.

The subsequent treatment with calcined alumina was intended to remove any vitamins left in the oil⁷ in addition to removing most of the residual colouring matter. Thus, as a result of the first three treatments, the sesame oil would be free to a great extent from mucilaginous matter, sesamin, sesamol, vitamins, colouring matter and odoriferous compounds. One would have expected that with this treatment with calcined alumina the oil would have further deteriorated. But surprisingly enough, this is not the case and the oil shows a remarkable recovery. In this connection it may be noted that the calcination was done at 700°C. in an electric furnace on chemically pure aluminium hydroxide, a temperature at which complete

conversion to alumina takes place. One possible explanation for this interesting phenomenon is that the treatment besides taking away the vitamins has also removed any pro-oxidants existing in the oil. But if this were so, then the subsequent treatment with bone charcoal should have further improved its stability since bone charcoal is a good adsorbent. Actually this is not the case and the oil deteriorates quickly.

The work done also confirms the observation made by the authors⁴ and others during recent times that under normal conditions of exposure to air and light, the peroxide value does not always correlate with organoleptic rancidity. Thus the oil sample had no rancid smell up to a peroxide value of 175.3 in Table I and 364 in

Table II, while in other cases (unpublished data) under similar conditions of exposure to air and light, the smell of rancidity has been noticed at very much lower levels of peroxide value.

ACKNOWLEDGEMENT

One of us (N. H. Harkare) wishes to thank the Laxminarayan Institute of Technology for the award of a Research Scholarship.

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LADY TATA MEMORIAL TRUST—SCIENTIFIC RESEARCH SCHOLARSHIPS, 1951-52

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1951-52 commencing from 1st July 1951. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of the head of a scientific department in a recognised research Institute

or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trustees. Candidates can obtain these instructions and other information they desire from the Secretary of the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay 1.

RAIN MAKING*

IN a freshly formed cloud the particles have a size of the order of a thousandth part of a millimetre and remain suspended in air. It was the general belief some years ago that cloud particles grow by continued condensation and coagulation with other drops while falling until it became sufficiently large to fall as a rain-drop. In 1933 Bergeron showed that a cloud was a colloidal suspension of water in air, an "aerosol", which will remain in this state of colloidal equilibrium until a sort of coagulation was released within it. Even when cloud tops go up to temperatures below freezing, they consist of a mixture of ice-particles and super-cooled water droplets.

By injecting pellets of dry ice (solid carbon dioxide) or silver iodide into a cloud, conditions may be created, which will cause a sudden coagulation of the cloud particles into rain-drops. Dry ice has temperatures of less than -75°C . so that a pellet of solid carbon dioxide falling through the cloud will cool a thin streak of air momentarily to such an extent that spontaneous ice-formation will take place in the cloud along this track. A pellet of dry ice about 1 cm. in diameter produces about a million ice nuclei in saturated air at about 20°C . A pellet of dry ice is thus able to set up a chain reaction throughout the cloud.

The latest experiments have shown that heavy rain may be obtained from a cumulus cloud by using a single pellet of dry ice shot into the cloud from a pistol to a horizontal

distance of 700 feet or more at a height of 1,000 or 2,000 feet above the freezing level. The heat generated by the freezing of the super-cooled water droplets greatly increases the turbulence and favours the start of a chain reaction.

By injecting silver iodide vapour from the base of a cloud, rain has been induced. In South Africa a cloud has been induced to rain by sprinkling water from the top.

The experiments on artificial rain are of considerable interest to India. During periods of weak monsoon or during a prolonged break in monsoon, scarcity of rains over certain areas is attended with disastrous results. It is not unusual during such periods to find cumulonimbus clouds forming and extending to considerable heights and dissipating away without producing any rain. The seeding of such clouds with dry ice may result in the production of rain which might save dying crops. The method may also be found useful during January to March when weak western disturbances pass across Northern India but cause insufficient winter rain.

One interesting application which has been thought of and made use of on a few occasions is to change the track of a cyclone. A cyclone has a definite structure and the quadrant in which rainfall occurs determines its direction of movement. There is a release of enormous amount of latent heat in that quadrant and consequently a fall of pressure. The cyclone moves in the direction of falling pressure. If therefore by seeding in another quadrant, a significant amount of rain is produced in that quadrant the direction of the cyclone will be changed.

* Abstract of the Twelfth Jagadish Chandra Bose Memorial Lecture, delivered by Dr. S. K. Banerji, till recently Director-General of Observatories, Govt. of India.

INDIGENOUS SUBSTITUTES FOR CORN STEEP LIQUOR—AN ESSENTIAL FORTIFYING AGENT FOR PENICILLIN PRODUCTION

IN connection with the Penicillin Factory, jointly sponsored by the Governments of India and Bombay, it is estimated that about 1,000 tons of corn steep liquor (50 per cent. of solids), have to be imported annually from America. This would cost the country some five to six lakhs of rupees, payable in hard currency.

Corn steep liquor is an essential fortifying agent which effects a fifty to hundred-fold increase in the yield of penicillin.

Researches on finding a suitable substitute for the corn steep liquor, conducted in the

Section of Fermentation Technology of the Indian Institute of Science during the last 12 months, have shown that there are a number of indigenous raw materials and trade wastes which can be processed to yield a product equal if not superior to the corn steep liquor. The washings from a lac factory now running to waste, after suitable treatment, have been found to constitute an equally potent substitute. The hydrolysates of the pupæ of the silkworm and aqueous extracts of germinated green gram, have been found to be definitely superior to the American product.

LETTERS TO THE EDITOR

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COMPRESSIBILITY AND COMPLEX FORMATION IN ELECTROLYTES

THE formation of definite complexes in mixtures of certain electrolytes is well known. Thus the formation of complex compounds between lead nitrate and alkali nitrates has been established by Nayar and Pande¹ who investigated various physical properties, such as viscosity, conductivity, freezing-point depression, and by Narasimhamurthy,² who investigated the Faraday rotation and magneto-optic anomaly. At the stoichiometric proportions corresponding to complexes existing in solution, maxima or minima appear in the curves exhibiting the variation in property with proportion of any one constituent. Since the compressibility of an electrolyte is, to a large extent, determined by the nature of the ions and the variation in properties of the solvent in the ionic vicinity, it might be expected to exhibit abnormalities when complexes are formed.

The compressibilities and their variation with concentration were estimated for the following mixtures of molar solutions, from a measurement of the ultrasonic velocities in these liquids: $\text{Pb}(\text{NO}_3)_2$ and KNO_3 , $\text{Pb}(\text{NO}_3)_2$ and NH_4NO_3 , $\text{Pb}(\text{NO}_3)_2$ and NaNO_3 , FeCl_3 and KCl . The well-known Bachem-Heidemann³ method of secondary interferences was employed. Parallel light from a mercury arc traversed the liquid cell in which stationary waves were

formed between the quartz at the bottom and the liquid-air interface. The pattern, formed by the secondary interferences of the emergent beam was viewed by a travelling microscope, some 50 half wave lengths of the ultrasonic wave being directly measured. Frequencies were measured by a precision wave-meter. Excitation was kept at a minimum and temperature variations did not exceed 0.1°C .

Adiabatic compressibilities have been determined using the relation $\beta_{ad} = 1/v^2\rho$; v = ultrasonic velocity ρ = density of the liquid. The partial molal compressibility

$$\frac{\beta V - \beta_0 V_0}{n_2} \approx \frac{\partial}{\partial n_2} (\beta V) = \bar{K}_2$$

is plotted against the molfraction of any one component.

The curves in the accompanying figure show the presence of minima at the stoichiometric proportions corresponding to definite complexes in solution. Thus, for $\text{Pb}(\text{NO}_3)_2 \cdot \text{KNO}_3$ molar solution mixtures, the minima occur at molar concn. 50%, 66%, and 80% of KNO_3 , corresponding to complexes $\text{Pb}(\text{NO}_3)_2 \cdot \text{KNO}_3$, $\text{Pb}(\text{NO}_3)_2 \cdot 2\text{KNO}_3$, $\text{Pb}(\text{NO}_3)_2 \cdot 4\text{KNO}_3$, and for the other curves, to complexes $\text{Pb}(\text{NO}_3)_2 \cdot \text{NH}_4\text{NO}_3$, $\text{Pb}(\text{NO}_3)_2 \cdot 2\text{NH}_4\text{NO}_3$, and $\text{FeCl}_3 \cdot 2\text{KCl}$. The curve for NaNO_3 - $\text{Pb}(\text{NO}_3)_2$ mixtures shows no kink, revealing no complex formation. These observations confirm the results of Nayar and Pande, and of Narasimhamurthy,

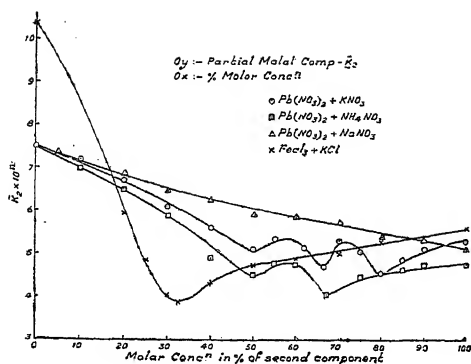


FIG. 1

A qualitative explanation of the observed variation of \bar{K}_2 is possible on the basis of the Debye-Huckel theory.⁴ The free energy of the solution of an electrolyte, expressed as the difference between that for concn. C and that for infinite dilution, is

$$\bar{F}_2 = \bar{F}_0 + \sum \nu_i RT \log c - \frac{A}{D^{1/2} T^{1/2}} (\sum \nu_i z_i^2)^{1/2} C^{1/2}$$

$A = \text{const.}$; $D = \text{dielectric const.}$, $\nu_i = \text{No. of ions, of charge } z_i \text{ per molecule.}$ The partial molal compressibility, is given by

$$-(\bar{K}_2 - K_0) = \frac{\partial^2}{\partial p^2} (\bar{F}_2 - \bar{F}_0)$$

and one obtains, $\bar{K}_2 - K_0 + f(D, P, V) (\sum \nu_i z_i^2)^{3/2} C^{1/2}$ (the form of $f(D, P, V)$ is immaterial. (It is positive.) The cases investigated involve the formation of complex ions, such as $Pb(NO_3)_4$ (Glasstone and Saunders⁵). The consequent decrease in valence factor $(\sum \nu_i z_i^2)^{1/2} K_2$ and ionic density are seen to involve a decrease in actually observed, especially for the concentrations at which complex formation is predominant.

I thank Prof. R. S. Krishnan for valuable guidance and suggestions.

Physics Dept., V. S. VENKATASUBRAMANIAN.
Indian Inst. of Science,
Bangalore,
November 27, 1950.

POLARISATION OF BRILLOUIN COMPONENTS IN LIGHT-SCATTERING IN LIQUIDS

ACCORDING to Brillouin's theory¹ of light-scattering in solids, scattering is, in effect, a coherent modified reflection of mono-chromatic light by a moving-mirror pattern in depth of density-fluctuations in the medium. The Doppler-shifted components of slightly altered frequency arising from such reflections should be perfectly polarised in the transverse direction. Sharp and well-defined Brillouin components are observed in light scattered by liquids

also; but my studies² have shown that they are highly, but not completely polarised. This observation has been confirmed by Bai³ and recently by Rank and his co-workers.⁴ I give below an explanation of this small, but finite percentage of depolarisation of the Brillouin components in liquids.

Frenkel's "hole theory" of liquids⁵ indicates two types of longitudinal sound waves in liquids, namely, (1) due to a purely translational vibration of molecules about their quasi-permanent equilibrium position, and (2) due to a translational accompaniment of angular vibration about the centre of gravity of the molecules. The first gives rise to longitudinal sound waves, in accordance with Brillouin's theory, causing density fluctuations in the medium. The predominant part of the transversely scattered light is due to these waves which satisfy the Bragg condition and constitutes the completely polarised portion of the Brillouin components. The second type of vibrations is also organised as the first and gives rise to two kinds of elastic waves, namely, (1) the longitudinal or ' l_a ' waves, and (2) the transverse or ' t_a ' waves. If the molecules are anisotropic, both of them will give rise to Brillouin scattering with change of frequency; but this being part of the anisotropic scattering, will be depolarised to the limit. The scattering due to ' t_a waves' is stronger of the two and evidence for both. The superposition of this weak scattering has been given by me in a recent note.⁶ The scattering by ' l_a waves' will be comparatively feeble and should have the same Doppler-shift of frequency as the purely translational component, as the velocity is the same for both. The superposition of this weak depolarised component on the strong 'density' component makes the latter feebly depolarised. A re-examination of my plates shows that the imperfection of polarisation of the components is more marked in liquids like benzene and tetralin, which possess a large depolarisation ratio. This gives support to the above conclusion.

Physics Dept., C. S. VENKATESWARAN.
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November 13, 1950.

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KAEMMERERITE FROM HULIKERE
MINES, HASSAN DISTRICT, MYSORE

DURING the course of a visit to Hulikere Chromite Mines, near Jambur, Hassan District, an attractive flaky mineral was seen associated with chromite. This was at first sight mistaken for talc; but on detailed study, it is seen to be the chrome-bearing variety of chlorite, viz., Kæmmererite. This variety has not been reported so far in India, except for a casual mention of its occurrence in the ultrabasic rocks of Chatnahalli, Mysore District, by Sri. M. G. C. Naidu, in the thesis submitted for M.Sc. Degree. The mineral shows a shining lavender colour, with a micaceous habit, coating the surface of the black ore. Under the microscope, the mineral appears as thin flakes, showing deep colours, due to high dispersion, surrounding the opaque ore-material. No constant relationship is observed between the quantity of chlorite under study, and the relative amount of opaque mineral.

The following statement shows the optical characters of this mineral in comparison with other Kæmmererites reported so far:—

Kæmmererite reported by A. N. Winchell ¹	Kæmmererite reported by E. V. Shannon ²	Kæmmererite under study
Optically positive 2V=Very small	Optically Negative 2V=Very small	Optically Negative Biaxial with very low optic axial angle inclining to almost uniaxial
Ng=1.509 Nm=? Np=1.586 Ng-Np=0.004	Ng=Nm=1.590 Np=1.587 Ng-Np=0.003 X=Pale red purple Y=Z=Red purple	Ng=1.575 Nm=? Np=1.570 Ng-Np=0.005 X=Pale pink V=Z=Pale reddish yellow

A. N. Winchell³ has expressed the view that chlorites containing chromium in any important amount replacing aluminium are easily recognised by their lavender or violet colour. M. F. Heddle⁴ and Kopetzky⁵ in analysing different samples of kæmmererite have indicated the presence of 5.97 p.c. and 7.49 p.c. of chromium oxide respectively, which is totally absent in the common chlorites.

The sample under study was kindly analysed chemically by Sri. S. Venkata Rao and Sri. T. L. Kasturirangacharya, Department of Chemistry, Central College, Bangalore, and the analysis showed the presence of 7.06% Cr₂O₃.

Further, in its mode of occurrence and characteristic association with chromite ore and serpentine in the form of thin flakes, the mineral strongly resembles the kæmmererite of Shetland Islands, reported by Frank Phillips.⁶

The mineral has, therefore, been identified as kæmmererite.

The author is indebted to Prof. L. Rama Rao, Dr. C. S. Pichamuthu and Sri. M. G. C. Naidu for their encouragement and guidance.

Dept. of Geology, M. N. VISWANATHIAH.
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MIXED ADSORPTION OF HYDROGEN
AND NITROGEN AT ELEVATED PRES-
SURES ON A PROMOTED IRON
SYNTHETIC AMMONIA CATALYST

For correlating adsorption with catalytic activity, the study of adsorption from a mixture of the gaseous reactants is likely to be more fruitful than the individual adsorption data of the constituent gases. So far, very little work has been carried out in the field of mixed adsorption, especially on catalytically active adsorbents, although the immense importance of this type of study has been recognised by several authors.^{1,2} This is mainly due to the complicated nature of the theory of mixed adsorption. Ghosh, Sastri and Kini^{3,4} studied the simultaneous adsorption of carbon monoxide and hydrogen from mixtures of the two gases on two Fischer-Tropsch catalysts. Emmett and Brunauer⁵ measured the adsorption of nitrogen on the doubly promoted catalyst 931, from a 3 H₂ + 1 N₂ mixture, at pressures upto 50 atmospheres and at 450° C., employing an indirect method. At this temperature, synthesis of ammonia was found to occur to an appreciable extent. They reported that, at equivalent pressures, the adsorption of nitrogen from the mixture was the same as that from the pure gas.

It was considered desirable to investigate the mixed adsorption of these gases at temperatures below that required for appreciable formation of ammonia. When the Fe—K₂O—Al₂O₃—TiO₂ catalyst, on which the adsorptions

of hydrogen⁶ and nitrogen⁷ had been previously determined, was exposed for several hours to the synthesis gas at 50 atmospheres and at temperatures upto 350° C., no trace of ammonia could be found on releasing the whole of the gas in the system through Nessler's Reagent. The individual adsorptions of hydrogen and nitrogen from a 3:1 mixture have, therefore, been studied on the same catalyst at six temperatures between 50° and 350° C. and at mixed pressures upto 50 atmospheres, employing the improved technique developed by the present authors.⁶

The results obtained indicate that, while the adsorption of hydrogen from the mixture increases regularly with its partial pressure at all the temperatures studied, that of nitrogen shows this regularity only at the highest temperature, viz., 350° C. In practically every case, the adsorption of hydrogen at a given partial pressure from the mixture is considerably higher than that from the pure gas at an equivalent pressure. Similarly, except at two temperatures, viz., 203° and 300° C., nitrogen adsorption is enhanced in the presence of hydrogen. These results are at variance with those of Brunauer and Emmett⁸ who reported that the pre-adsorption of nitrogen at about 400° C. caused an enhancement of hydrogen-adsorption only on the alumina-promoted catalyst 954 and attributed the effect to the formation of imide and amide complexes. On the doubly promoted catalyst 931, they observed that the chemisorption of nitrogen inhibited almost atom for atom the chemisorption of hydrogen at 100° C.

At 350° C., certain interesting results are obtained which, probably reflect a fundamental variation in the nature of the phenomenon as the reaction temperature is approached. It is found that, when the partial pressure of nitrogen exceeds about 7 atmospheres, the ratio of the respective increments of nitrogen and hydrogen adsorptions varies successively from 1 N₂ : 1 H₂, through 1 N₂ : 2 H₂, to finally 1 N₂ : 3 H₂. This observation suggests the successive formation of =NH, -NH₂ and NH₃ complexes on the active surface of the catalyst.

Finding no evidence of complex formation on the active doubly promoted catalyst 931 at 100° C., Brunauer and Emmett⁸ suggested that the formation of such complexes had a poisoning effect on the synthesis. The present investigation, especially the results obtained at 350° C., on the contrary, lead one to the view that the NH and NH₂ complexes act much rather as natural intermediates and precursors of the

ammonia molecule ultimately formed on, and desorbed from, the surface. The latter view is substantially in agreement with the mechanism originally postulated by Frankenburger^{9,10} and by Emmett¹¹ as well.

The authors are grateful to Sir Jnan Chandra Ghosh and Prof. B. Sanjiva Rao for their kind interest and encouragement.

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PURIFICATION OF MUSTARD OIL CONTAMINATED WITH ARGEMONE OIL

CONTAMINATION of mustard oil with argemone oil and its effect on the incidence of epidemic dropsy¹ has been known for some time.

Roy² has recently published a method in which the removal of toxic alkaloids has been effected by treatment of the oil with phosphoric acid and subsequent removal of excess phosphoric acid with lime. Sen Gupta and Nair³ have tried to purify the oil by treatment with Fuller's earth at 60° C. for about one hour while agitating the oil by blowing air through it. The following simple method effectively removes the toxic alkaloids from contaminated mustard oil. The oil is stirred vigorously with a 20 per cent. solution of ferric chloride for about 20 minutes. The resulting emulsion is kept on a water-bath for half an hour and then allowed to settle for about two hours. The supernatant oil which could be filtered off is free from argemone oil as tested by the modified ferric chloride test.⁴ 20 per cent. of ferric chloride solution to the extent of 10 per cent. on the weight of oil is found to be sufficient for oils containing up to 5 per cent. of argemone oil. A further treatment of oil with about ½ per cent. of Fuller's earth may be used with advantage to improve the colour of the oil and ensures freedom from any traces of ferric chloride left behind. The

characteristics of the purified oil are not affected by the treatment.

A detailed paper on the work will be published shortly.

B. Technological Inst., OM PRAKASH.
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INHERITANCE OF 'PISTILLATE' IN COTTON

'PISTILLATE'—a new character in *desi* cotton was reported and described as one different from the 'petalody'.³ It was an interesting case of unisexuality of the male sterile type possessing staminode structures, branched stigma and fluted ovary. The type set normal bolls when dusted with foreign pollen and was being maintained by recovering the mutant in alternate generations. The genetics of 'pistillate' were studied at Coimbatore by crossing with normal types, viz., 1274 and CST.3.

The normal was fully dominant and the segregation in F₂ was simple in cross with 1274. The other type CST.3 was a green stem/ghost¹ carrying the anthocyanin gene R_2^{as} . A two factor segregation for 'pistillate' and "ghost" with independent assortment of 27, 5, 10 and 2 plants under the four respective phenotypes, as normal, R_2^{as} pistillate, R_2^{as} normal and as pistillate, and a good fit for 9 : 3 : 3 : 1 di-hybrid ratio were recorded in the second generation.

This new monogenic recessive in *G. arboreum* assigned the gene symbol *pte*.

Agricultural College R. BALASUBRAHMANYAN.
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CLARITY OF MALE CELLS IN POLLEN GRAINS OF SOME UMBELLIFERAE

The pollen grains of *Coriandrum sativum* L., *Cuminum cyminum* L., *Daucus carota* L., *Foeniculum vulgare* Mill., *Heracleum candicans* Willd., *Peucedanum graveolens* Benth., *Pimpinella diversifolia* D.C., and *Seseli indicum* W.A.,

were studied from acetocarmine preparations, cleared with chloral hydrate (Maheshwari and Wulff¹), and made permanent by the McClintock method.²

The young microspore is usually pear-shaped. At maturity, it becomes ellipsoidal with three germ pores at the equatorial region. Its nucleus lies towards one end where it divides, in a line with the longitudinal axis of the pollen grain, to form a faintly stained tube nucleus and brightly stained generative nucleus. The latter soon elongates and organises a thin sheath of hyaline cytoplasm. In *Coriandrum sativum*, *Pimpinella diversifolia* and *Seseli indicum* the generative cell mostly divides at one end of the pollen grain, whereas in *Cuminum cyminum*, *Daucus carota*, *Foeniculum vulgare*, *Heracleum candicans* and *Peucedanum graveolens* it moves to the equatorial region and divides there to form two sperm cells.

Sperm cells of the above-mentioned plants are elongated but variable in the length and shape of their ends, which may be blunt or pointed in different species. In *Coriandrum sativum*, *Daucus carota* and *Peucedanum graveolens*, one end of the male cell is pointed while the other blunt; in *Foeniculum vulgare* both ends are pointed and finally in *Heracleum candicans*, *Pimpinella diversifolia* and *Seseli indicum* both ends of a sperm cell are blunt. In the last three cases the pollen grains settle in such a position that the sperm cells mostly lie perpendicular to the surface of the slide, so that only one of the blunt ends is visible, whose circular outline is liable to be mistaken for a round nucleus.

The sperm cells, soon after their formation, begin to move apart towards opposite poles. A mature pollen grain, which is three-celled, thus has a round tube nucleus at the equatorial region and two elongated sperm cells lying one at each pole, showing a fixed polarity.

My sincere thanks are due to Dr. Maheshwari for his valuable suggestions and Dr. Bahadur Singh for his kind guidance.

Dept. of Botany, R. L. PALIWAL.
B. R. College, Agra,
August 1950.

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TEMPERATURE AS A SELECTIVE FACTOR FOR YEAST MUTANTS

YEASTS appear to be highly suitable for investigations on the mutagenic action of physical¹ as well as chemical² agencies. The two chromosome brewery yeast,³ BY 1, shows a seasonal variation in the predominance of the

various gene mutants.⁴ For any accurate work on the evaluation of the mutagenic property of various agencies the prime consideration is the genetic purity of the material.⁵ The very short generation time of the two chromosome strain results in the quick appearance of the mutants, even though the rate of mutation in yeasts may be identical with that in higher organisms. To get a pure culture for any specific genic constitution either the mutational step should be inhibited by some agency⁶ or the environment should be used as a selective factor.

Mallya and Subramaniam⁷ demonstrated that strains having different genic constitutions show different rates of growth under identical conditions. When grown at room temperature there is a regular sequence in the appearance of the mutants. The above observations suggested the possibility that by con-

evidenced by the *Smooth* sector seen on the right-hand side of the colony in Photo 1. But the shape of the sector indicates that the cells composing it have an inferior rate of growth. In Photo 2 (cf. 4 Photo 10) on the other hand, the four *smooth* sectors start almost from the centre of the colony. The obvious conclusion is that the particular temperature conditions form only a selective environment but do not inhibit the mutational step. The control run at room temperature gave the giant colony presented as Photo 3. Each allelic combination may have a specific temperature optimum^{9,10} above or below which its proper functioning may be altered considerably.¹¹

The observations recorded above suggest that the optimum temperature for the growth of the *Rough II* type of mutant is between 30-31° C. Naturally the *Rough II* cells would be inferior

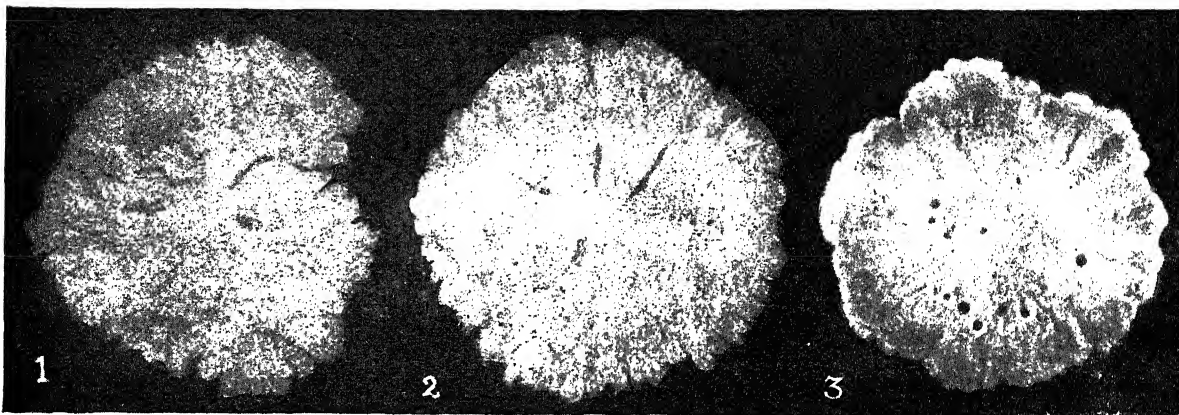


Photo. 1. BV 1, Barley Malt, 5.0 cm. 17 day growth, 31°C. photographed on 30-9-1949.

Photo. 2. BV 1, Barley Malt, 5.5 cm. 17 day growth, 31°C. 30-9-1949.

Photo. 3. BV 1, Barley Malt, 2.6 cm. 15 day growth, room temperature, 28-9-1949.

trolling the temperature, specific types could be isolated and kept unchanged.

Culture of the two chromosomes strain were grown continuously in wort in an incubator at a temperature of 30-31° C. Giant colony inoculations were carried out at periodic intervals and the giant colonies themselves were grown at the above temperature. While at room temperature the diameter of the colonies was only ca. 4.0 cm.,⁸ their size ranged from 5-6 cm. when grown at 31° C. Naturally, the final expression of the sculpturing in such colonies was dependent on the depth of the medium in the petri dish and the sample of malt employed. Under ideal conditions, the colonies which developed were of the *Rough II* type (Photo 1) having the genic constitution *Rough/Rough*.⁴ The temperature inside the incubator (31° C.) has, therefore, acted as a selective environment for the *Rough II* type. Mutations do occur as

in their growth-rate⁷ to the other types at temperatures above or below this optimum.

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PHOTOPERIODIC STUDIES IN INDIAN
VEGETABLESII. *Amaranthus gangeticus* var. *oleraceus*
Roxb.

Of the few species of *Amaranthus* studied photoperiodically, Allard and Garner (1940) reported *A. hybridus* and *A. sp. Dreersunrise* as indeterminate ones and Fuller (1949)¹ classified *A. caudatus* L. as a short day species. Samantarai and Panigrahi report that *A. gangeticus* var. *tristis* is also a short day species.

In the present work, photoperiodic response of *Amaranthus gangeticus* var. *oleraceus* to varying periods of illumination is reported. Plants were grown in earthen-ware pots of 6" × 10" and the soil consisted of silt and farm-yard manure in proportions of 2 : 1. The seeds

"Phillips" bulb kept at a distance of 5' from the growing apices of plants till April 30, when the experiment terminated.

Table I shows the vegetative characters and periods of flowering in plants receiving varying periods of illumination.

CONCLUSION:—*Amaranthus gangeticus* var. *oleraceus* is distinctly a short day species. Even 12 hours daily exposure is sufficient to render the plant vegetative, although *Amaranthus gangeticus* var. *tristis* flowers copiously under identical conditions.² The plants show the best vegetative growth under 18 hours daily exposure but under continuous illumination they have no apical dominance and the leaves are shrivelled and hence this is not conducive for good vegetative growth.

TABLE I

Nature of treatment	No. of days taken for flower bud formation from the date of sowing	Length per plant in cm.		No. of leaves per plant	Weight per 100 plants in grams			
					Fresh weight		Dry weight	
		Root	Stem		Root	Stem	Root	Stem
6 hours (9 a.m.-3 p.m.)	32	10.6	15.4	20	14.8	191	5	20
12 hours	.. vegetative throughout	11.5	16.1	21	37.5	234	8.3	23
18 hours	.. do do	12.7	18.5	25	85.5	662.5	18.5	181
24 hours	.. do do	12.6	17.9	21	70.4	652.7	16.2	171.5
Control	.. 39	15.5	13.4	23	190	405.4	42.3	102.7

were sown on February 10, 1950, at 8 a.m. and the pots were divided into 5 groups of 4 each, ten plants growing per pot. Periods of illumination consisted of 0, 6, 12, 18, 24 hours and



control. Daylight was the main source of light and wherever necessary, it was supplemented by electric light from a 1,000-watt

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Botany Dept.,
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October 28, 1950.

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HYDROLYSED FERRIC SALT AS
BETTER FLOCCULATING AGENT

FERRIC SALTS in solution undergo hydrolysis, which is directly proportional to the temperature and time and inversely proportional to the concentration of the ferric ions (Jacques and Lamb¹). If this hydrolysed solution of ferric salt is used for coagulating the negatively-charged antimony sulphide sol, it is observed

TABLE I

Normality of FeCl_3	0.00535	0.0107	0.0214	0.0412	0.107	0.124
Coagulation value at 0 hr.	7.8 c.c.	6.5 c.c.	6.0 c.c.	5.8 c.c.	5.3 c.c.	5.0 c.c.
Coagulation value at 2 hrs. of hydrolysis	5.6 c.c.	4.9 c.c.	4.2 c.c.	4.0 c.c.	3.6 c.c.	3.4 c.c.

that a lower amount of the hydrolysed salt is required for coagulation as compared with that of an unhydrolysed sample of the ferric salt. Results obtained with ferric chloride are given in Table I. The time of hydrolysis is 2 hours and the temperature 60°C . Coagulation values have been obtained by finding out the amount of ferric chloride necessary to obtain a standard turbidity in 2 c.c. of an antimony sulphide sol.

Similar results are obtained with the nitrate, sulphate and alum of iron.

Ferric hydroxide formed by hydrolysis is stabilised by the adsorption of positive ions, forming the more powerfully coagulating colloidal ferric hydroxide. The coagulation values obtained with the negatively-charged antimony sulphide sol, therefore, go on decreasing as the hydrolysis proceeds. It appears that the use of iron in a colloidal state is more suitable and economical than its use in the ionic form, wherever it has to function as a flocculating agent. Further work in this subject is in progress.

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BACTERIAL LEAF-SPOT OF CASTOR

A SEVERE bacterial leaf-spot of castor (*Ricinus communis* L.) similar to that reported by Yoshi and Takimoto (1928)¹ from Japan and Korea and by Hansford (1935)² from Uganda was observed at Anand, Dist. Kaira in December, 1949.

On the leaves, the pathogen produces few to numerous, small round, water-soaked spots measuring initially 0.5 to 1 mm., mostly aggregated towards the tip. Some of them increase in size (2 to 3 mm.), become angular and dark-brown to jet black. On the other hand, the undeveloped spots remain circular with pale-centre and dark-margins. When coalescent, spots become irregular in shape, the areas around such spots turn pale-brown and brittle. Bacterial ooze in the form of small shining beads or fine scales is found on both sides of the spot which get depressed on the under-surface of the leaves; the corresponding areas

on the upper surface are raised and present a pale-white appearance due to bacterial exudation. The pathogen infects cotyledons, leaves and veins.

Description of the pathogen:—Short rods; single or in chains; $1.5 \times 0.7 \mu$; Gram negative; capsulated; no spores; on potato dextrose agar, the colonies are circular with lobate margins, smooth, shining, convex, with striations at the periphery, measuring 1.2 cm. in diameter after 7 days; colour marguerite yellow; gelation liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; ammonia and hydrogen sulphide produced; nitrates not reduced; acid but no gas in dextrose, sucrose and lactose; no growth in salicin; optimum temperature for growth 31°C .; thermal death point about 51°C .; pathogenic on castor.

The disease is similar to that caused by *Xanthomonas ricinicola* (Elliott) Dowson.

Plant Path. Lab., M. K. PATEL.
Agric. Coll., Poona, Y. S. KULKARNI.
July 30, 1950. G. W. DHANDE.

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THE REFLECTANCE SPECTRUM OF IGNITED SOILS AS AN INDICATION OF THE MINERALOGICAL COMPOSITION OF THEIR CLAYS

RAMAMOORTHY and Viswanath¹ have studied the reflectance spectra of black, red, yellow and grey soils both before and after ignition at 500°C . Nagelschmidt, Desai and Muir² have shown that the dominant clay minerals in the black and red soils from India are those of the montmorillonite and kaolin groups respectively. Nagelschmidt³ reports from X-ray and thermal studies that clay minerals of the kaolin group undergo lattice destruction and break down at 500°C ., while those of the montmorillonite-mica group are quite stable upto 800°C . or even more. Thus, the particles of the inorganic colloidal stains spread on the soil skeleton in the red soils should disintegrate on ignition at moderate temperatures, while those in the black soils need not do so. Puri,⁴ on the other hand, has shown that on ignition, the black soils have their clay complexes built into bigger aggregates by condensation of the hydroxyl groups. It should be possible, therefore, to differentiate

the dominant clay mineral of those soils by the mere reduction or increase on ignition in the particle size of the colloidal stains, which can be judged from the reflectance spectra of the soils by applying the laws of light scattering.

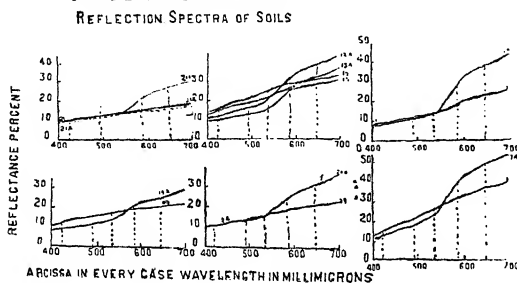


FIG. 1

Fig. 1 gives the reflectance spectra of natural and ignited soils obtained on a G.E.C. self-recording photoelectric spectrophotometer by the method reported by us.¹ Curves marked by a number refer to the natural soil and those

clay, while Dacca (7) and Taliparamba (1) with big slopes or smaller number of bigger aggregates have kaolin group dominating the clay. These results from the reflectance curves are in accordance with the base exchange capacity per 100 gm. of clay of different clay minerals and are in conformity with the observations of Nagelschmidt, Desai and Muir² from X-ray studies on the distribution of montmorillonite and kaolin in Indian soils. Hari-purhazara (12) and Lyallpur (15) soils have intermediate values of the steep. That this is due to dominance of the mica group in these soils and not to a mixture of the montmorillonite with a member of the kaolin group is shown by the greatest depression on ignition in the violet reflectance, which cannot be explained if it were a mixture of the above two types. This view is supported by the low percentages of clay-K and clay-Mg, that are in the exchangeable form which are characteristic of the mica group.

TABLE I

Ref. No. on curves (Fig. 1)	Soil from	Colour of the soil	% Reflectance, at violet end	Max. slope of curve in degrees	% Reflectance at red end	Wave length at which max. slope occurs	B.E. Capacity in m.e. per 100 gr. clay
21	<i>Padehon</i>						
	Natural	Black	8.7	8	17.5	0.495 μ	89
21A	Ignited		8.0	36	29.5	0.54	
19	<i>Powerkhera</i>						
	Natural	-do-	11.0	9	21.2	0.4825	85
19A	Ignited		8.5	31	28.5	0.54	
1	<i>Taliparamba</i>						
	Natural	Red latteritic	8.0	25 $\frac{1}{2}$	25.0	0.54	31
1A	Ignited		7.5	54	43.8	0.55	
7	<i>Dacca</i>						
	Natural	-do-	13.0	27 $\frac{1}{2}$	40.5	0.495	38
7A	Ignited	yellow	11.5	57	54	0.545	
12	<i>Hari-purhazara</i>						
	Natural	Gray	14.0	21	32.5	0.49	73
12A	Ignited		11.5	45	43 $\frac{1}{2}$	0.54	
15	<i>Lyallpur</i>						
	Natural	Pinkish grey	13.0	18 $\frac{1}{2}$	30.0	0.51	72
15A	Ignited		9.7	42	32.0	0.55	

with the letter 'A' added refer to the ignited soil. The ordinates are the percentage reflectance and the abscissa are the wavelength in millimicrons, and are cut by the dotted vertical lines into six colours of the visible spectrum (violet, blue, green, yellow, orange and red). The derived data are presented in Table I.

According to Gamble and Barnet,⁵ the greater steep is associated with finer particle size and the particles are more monodispersed, than when the steep is less, with less reflectance in the red end. This shows that Padehon (21) and Powerkhera (19) soils on ignition have small slope of 31-36° and therefore a larger number of bigger aggregates indicating montmorillonite group as dominating their

Further details and interpretation of the reflectance curves will appear elsewhere. This method appears to provide a quick characterisation of clays and might be of interest both in soil science and ceramic industry.

8A/85, W.E. Area, B. VISWANATH.

Pusa Road, New Delhi-5.

Ind. Agrl. Res. Inst., B. RAMA MOORTHY.
New Delhi,

November 19, 1950.

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REVIEWS

Atomic Physics. By J. B. Rajam, S.J., Head of the Dept. of Physics, St. Joseph's College, Trichinopoly, 1950. Pp. 1,056.

This is a welcome addition to the very small number of books by Indian authors on advanced Physics. The book, consisting of over 1,000 pages, is divided into three main parts. The first deals with the electron, positive rays, X-rays and radio-activity; the second, with relativity and the wave nature of matter and the third with spectra, cosmic rays and the nucleus.

The book, according to the author, is mainly intended for the pass and honours students. He rightly admits that while this contains more than what is needed for the pass student, it does not cover fully the honours syllabus. Owing, however, to the almost semi-popular exposition, which does not take much for granted, the book would also prove extremely useful to persons of a fairly good general education, particularly in these days when the atom bomb has aroused the interest of the educated public in nuclear physics to which the author has devoted a considerable part of the book.

It must, however, be pointed out that the photographs of the great men of Physics have room for considerable improvement. Again the graphical representations have not been prepared with the attention they deserve. For instance, the Bohr-Coster diagram for the limits of the K- and L- series are practically parallel to one another. Statements like "there is a certain critical distance within which it (the Coulombian law of force) fails" or "ceases" on p. 973, or "it (neutrino) is more akin to a photon than to a material particle" on p. 688 or again "the n-n and p-p attractive forces, if they exist, are . . . vanishingly small" on p. 1027 are not precise and may suitably be altered in subsequent editions.

The lack of even a very brief bibliography is rather a serious drawback in a book of this nature.

S. B. B.

Physical Chemistry of High Polymeric Systems. By H. Mark and A. V. Tobolsky. (Interscience Publishers, 215, IV Ave, New York), 1950. Pp. xi + 506. Price \$6.50.

All polymer chemists are fully familiar with the High Polymer series, at present running

into ten volumes, edited by Mark, Whitby and others. The new edition of Volume II of this series, after ten years of its original publications, makes it the only up-to-date book on the subject. In the new edition, Dr. Mark is assisted by Dr. Tobolsky, and there are additional 150 pages, 56 illustrations and 13 tables. A special feature of this edition is the inclusion of appropriate and helpful examples at the end of each chapter. The authors have very systematically put in between covers all the relevant information that is scattered in numerous publications during the last ten years.

The first seven chapters are devoted to the geometry and crystal structure of ordinary molecules and subsequently of macro-molecules, together with a well-written description of molecular spectra and X-rays as tools for their evaluation. The next three chapters deal with the thermodynamics of polymer solutions where osmotic pressure and viscosity have been adequately discussed and a brief description of sedimentation and flow birefringence techniques as applied to macromolecules in solution is also given. The next chapter gives a brief description of the mechanical properties of high polymers and their relation to molecular structure. The last three chapters on kinetics and degradation of polymers are fresh additions to this edition and present more detailed information than the earlier chapters and include a thorough survey of the developments and progress in this important aspect of polymer chemistry.

The integrated picture of the physical chemistry of high polymers presented by the authors keeps even a casual reader interested throughout. Numerous references to pertinent original publications have been inserted for the interested reader. The paper and quality of printing are excellent.

S. L. KAPUR.

Apples and Apple Products. By R. M. Smock and A. M. Neubert. (Interscience Publishers), 1950. Pp. xvi + 486. Price \$7.80.

This is Volume II in the series of monographs on economic food crops designed to present a critical account of various factors, agricultural, physiological and chemical, influencing crop production and utilization. It is seldom that one gets information, within a single book, which is of value to chemists,

physiologists, botanists, nutritionists, and food manufacturers alike. Indeed, it has often been a rather common experience to find a lack of understanding of each other's problems in the different groups. Thus, on the one side, the requirements of the food processor are not always reckoned by those dealing with the various aspects of crop production while, on the other side, he probably evinces a lack of sufficient appreciation of the problems in the large-scale production of uniform crops of high quality.

It is for such reasons that an integrated discussion of the problems facing both groups has unusual practical value. The volume under review deals with the chemistry, physiology and processing of this one fruit, apple. While chemical composition and physiological behaviour are the central themes, the book also deals with botanical aspects and production factors as well as with detailed methods of utilization and processing. The various chapters in the book include: history and world distribution; tree and fruit characteristics; development and anatomy of mature fruit; physiology and composition of the developing and mature fruit, including treatments on enzymic and vitamin changes and influence on these of cultural and environmental factors; factors affecting fruit maturity, storage life and quality; preparation and preservation of apple products by drying, canning, and freezing; production of apple juice, syrup, and concentrate; fermented apple products; apple butter, jelly and other confections; and, finally, utilization of apple pomace. There are appendices giving production and utilization statistics and the book is throughout illustrated with photographs, flow diagrams, charts, data, and tabular statements. References have been cited to establish authority and to assist the reader who may wish to read more fully on any particular topic.

To deal with such a diversity of topics calls for a difficult task from the authors and this they have admirably succeeded in accomplishing.

A. SREENIVASAN.

Biological Studies with Polonium, Radium and Plutonium. Edited by R. M. Fink. (McGraw-Hill Book Co., Inc., New York). Pp. 441. Price \$3.75.

Biological studies were carried out with polonium, radium and plutonium by Dr. Fink and his colleagues in the University of Rochester under the auspices of the Manhattan Project of the Atomic Energy Commission, and the volume under review is largely a report of their in-

vestigations along with a critical appraisal of the literature concerning the retention, distribution and toxicity of the three elements.

Dr. Fink has ably edited the large amount of valuable material by dividing it into eight chapters. The first three deal with the general methods used and the results obtained on polonium metabolism in rats, rabbits and in human subjects. The next three chapters relate to the distribution and excretion of radium beginning with a comprehensive survey of literature on radium metabolism. It is evident that in spite of the extensive use of radium, only few clear-cut and thorough quantitative experimental studies have so far been carried out on radium metabolism either in man or in the experimental animal. The last two chapters give details of toxicity studies on intravenous lethal dosage of polonium, plutonium and radium in rats. Preliminary experiments were first carried out to determine the approximate dosage values. It is interesting to note that the difference observed in their relative toxicities closely parallel those observed in the half lives, distribution in the body and rate of excretion of these three elements.

These biological studies, undertaken mostly in rats, even though of short duration, were carried out in the hope that these data taken in conjunction with known tolerance limits for radium and X-rays in man may prove to be of value in arriving at tolerance figures for polonium and plutonium. The results obtained constitute, therefore, an important contribution to our efforts in understanding the general problem of long-term human tolerance to a variety of radio-active materials, and the volume should prove invaluable to all those engaged either in the therapeutic application or fundamental investigation of radio-active isotopes.

P. S. SARMA.

Plant and Soil Water Relationships. By Paul J. Kramer, Professor of Botany, Duke University. (McGraw-Hill Book Co., Inc., N.Y.), 1949. Pp. xiii + 347. Price \$4.50.

In any scheme of things that deal with tropical agriculture, two factors must be carefully considered, soil moisture and soil organic matter. Paul J. Kramer's book supplies the much wanted information on plant and soil water relationships in a precise and concise manner. It combines a discussion of soil moisture and the factors affecting its availability to plants, with a discussion of plant water relations. Considerable attention has been paid to the application of basic physical and physiological principles in explaining plant growth,

The various irrigation projects that are existing, those in execution and those being planned will have to make every drop of water that is collected do its duty if they are to prove efficient. For a planting industry mostly located in heavy rainfall areas, the problems are of a varying nature. During the heavy rain periods the soil is oversaturated and suffused with water, but during long periods following this rainy season drought occurs. Defoliation as a consequence of lack of drainage and poor re-foliation for lack of moisture are problems that are facing the coffee and tea industries respectively. Methods of soil management have to be devised after careful study of the conditions affecting the plants. This book supplies information required for planning such studies and should prove useful to all agriculturists in the country. Written in admirable style and covering eleven chapters running over nearly three hundred pages, it is a worthy addition to the series of excellent books published by Messrs. McGraw-Hill Book Company. As usual, a very select bibliography and a good subject and author index are placed at the end of the book.

N. G. C.

Java Tapioca, Its Manufacture, Grading and Use. By L. W. J. Holleman. (O.S.R. Publication 22).

This communication reviews the progress made in Java during the past few decades in the production of tapioca flour for industrial use. The methods of processing, collection from big as well as small producers, grading and testing have been discussed. The organisation has helped to maintain and offer to the overseas consumers, products of the desired quality. The production of tapioca in Java has been encouraged to the maximum possible extent, not only because of its export value but also in consideration of its utility as an article of human food, especially during seasons of rice shortage.

V. S.

Cell Physiology and Pharmacology. By J. F. Danielli. (Elsevier Publishing Co., Inc., New York), 1950. Pp. vi + 156. Price \$3.00.

One of the most fascinating and difficult field of pharmacological study is that which deals with the mechanism of drug action. The chief difficulty in the interpretation of the action of a drug lies in the lack of precise knowledge as to the actual site of drug action. Considerable experimental evidence has accumulated during recent years which shows that the biological activity of a drug depends on molecular interaction with the biological system involv-

ing differential solubility in the cell lipids, adsorption at cell interfaces or more specifically polar interaction and specific stereo-chemical relationship of the reactants in the system.

Too little is known of cellular physiology to permit an interpretation of the mechanism of the action of drugs. The author has attempted to explain the physico-chemical principles involved in the reactions of organised matter. Discussing in Chapter I the cell as physico-chemical unit, he outlines the main aspects of the cytological background, and describes in some detail properties of the molecular types constituting the cell, viz., the unit of structure, control of enzyme systems, the dielectric properties, membrane properties and the dynamic condition of cell constituents. In subsequent chapters the author discusses the possible action of drugs on surfaces, membrane permeability and drug action, and enzymes and drug action. Attempting to explain the mechanism of the action of narcotics, the author discusses the theories of action upon surfaces, theories based on oil-water partition effects and theories based on action on enzymes. There are many apparent exceptions to such isolated principles.

In the concluding chapter on "Responses of the Cells on Biological Level", a few positive statements pertaining to the more general concepts of this subject have been made. A considerable number of drugs have been classed as mitotic poisons, and in the chemotherapy of cancer this particular aspect of mechanism of drug action has been most interesting. It has also been supposed that some drugs have their main action upon the cytoplasm, while others have their action on the nucleus; but the correctness of these hypotheses has not been definitely established especially with respect to the latter. Possible modes of drug action upon genes are still very complicated and no definite explanation is available.

The book is intended to direct the attention to the biologic aspect of drug action. Could we determine the relationship between the drug receptor group in the cell and the external drug phase, we should be in a much better position than we are at present to collaborate with the chemist in the synthesis of new compounds. The author's aim is to stimulate biological research on drug action with this end in view.

The book is of great value to the pharmacologists, chemists and biologists. It is a very stimulating contribution and is highly useful for research in biological field.

N. N. DE.

SCIENCE NOTES AND NEWS

Royal Society Awards for 1950

The award of two Royal Medals for 1950—one to Sir Edward Appleton and the other to Dr. C. F. A. Pantin—has been announced by the Royal Society.

Sir Edward Appleton wins the award for his work on the transmission of electro-magnetic waves round the earth and for his investigations into the ionic state of the upper atmosphere. Dr. Pantin made a notable contribution to the comparative physiology of invertebrates.

Sir James Chadwick, Air Commodore Sir Frank Whittle, Sir John Shimonsen, Prof. F. E. Fritsch and Prof. M. Born are the recipients of the Copley, Rumford, Davy, Darwin and Hughes Medals respectively.

Award of Research Degrees

On the recommendation of the Board of Examiners consisting of Prof. H. W. Thompson, F.R.S., Prof. M. G. Evans, F.R.S. and Prof. S. R. Khastgir, D.Sc.; and Prof. R. W. Lunn, Prof. McKie and Prof. McBain, the Banaras University conferred the degree of Ph.D. on Messrs. B. B. Prasad and G. R. Phansalkar, for theses on "Joshi-effect in H.F. Conduction in Chlorine" and "Some Thermo-Chemical Studies", respectively.

Admission to Institutions in Trinidad

Indian students wishing to apply for admission to the Imperial College of Tropical Agriculture, Trinidad, West Indies, or to any other institution in that country are required to forward their applications to the Ministry of Education, Government of India, New Delhi, for onward transmission to the Indian Commissioner, Port of Spain, Trinidad. Applications for admission to the College should not be made to the High Commissioner for India in London.

Conference on Sugarcane

The First Biennial Conference of Sugarcane Research Workers will be held at Coimbatore from 9th to 12th January 1951, under the Presidentship of the Hon'ble Shri. M. Thirumala Rao, Deputy Minister for Food, Government of India.

Union Catalogue of Periodicals Available in South Asia

The pilot fascicule of the Union Catalogue of Periodical Publications with the holdings in

physics and chemistry available in the libraries of South Asia was issued by the middle of May, 1950. Copies of it were sent to many known libraries and experts in documentation and library science. Their new features are: (1) Subject classification of the entries; (2) Details about the changes in titles, etc.; (3) Class number to bring all related subjects together; (4) Numerical notation of the location of the libraries, consecutive numbers denoting adjacent areas.

The Union Catalogue will be maintained in cards and will be in the charge of the Delhi University Library so as to provide easy access to seekers and to facilitate replies being promptly sent to postal enquiries.

Indian Botanical Society

The following were duly elected as Office-bearers of the Indian Botanical Society for the year 1951:

President: Dr. P. Maheshwari, Delhi. *Vice-Presidents:* (1) Dr. S. P. Agharkar, Poona; (2) Dr. B. P. Pal, Delhi. *Hony. Secretary:* Dr. R. Misra, Sagar. *Treasurer:* Dr. R. L. Nirula, Nagpur. *Editor-in-Chief:* Dr. A. C. Joshi, Hoshiarpur. *Councillors:* (1) Dr. A. C. Joshi, Hoshiarpur; (2) Dr. T. S. Mahabale, Bombay; (3) Dr. Y. Bharadwaja, Banaras; (4) Dr. L. N. Rao, Bangalore; (5) Dr. I. Banerji, Calcutta; (6) Dr. G. P. Majumdar, Calcutta; (7) Mrs. E. Gonzalves, Dharwar; (8) Sri. M. B. Raizada, Dehra Dun; (9) Dr. P. N. Mehra, Amritsar; (10) Dr. R. K. Saxena, Allahabad. *Members of the Editorial Board:* (1) Dr. P. Maheshwari, Delhi; (2) Dr. B. P. Pal, New Delhi; (3) Dr. A. C. Joshi, Hoshiarpur; (4) Dr. P. Parija, Banaras. *Business Manager:* Dr. T. S. Mahabale, Bombay.

National Institute of Sciences of India

At the Anniversary General Meeting of the National Institute of Sciences of India held at Bangalore on the 1st January, 1951, the following were duly elected office-bearers and other members of the Council of the Institute for the year 1951:

President: Dr. S. L. Hora, Calcutta. *Vice-Presidents:* (1) Dr. K. S. Krishnan, Delhi; (2) Prof. P. Parija, Banaras. *Treasurer:* Dr. C. G. Pandit, Delhi. *Foreign Secretary:* Dr. J. N. Mukherjee, Delhi. *Secretaries:* (1) Prof. D. S. Kothari, Delhi; (2) Dr. H. S. Pruthi, Delhi,

of Publications: Mr. J. M. Sen, Calcutta. Members of Council: Dr. S. P. Agharwal, Poona; Prof. K. N. Bahl, Lucknow; Dr. S. Banerji, Calcutta; Prof. H. J. Bhabha, Bombay; Prof. S. Bhagavantam, Hyderabad; B. B. Dey, Madras; Dr. B. C. Guha, Calcutta; Prof. A. C. Joshi, Hoshiarpur; Prof. R. C. Mukherjee, Delhi; Dr. B. P. Pal, Delhi; Dr. V. G. Vaidya, Indore; Dr. Mata Prasad, Bombay; L. A. Ramdas, Poona; Prof. M. N. Saha, Calcutta; Prof. N. R. Sen, Calcutta; Dr. P. V. Satyam, Delhi; Dr. A. C. Ukil, Calcutta.

The following were elected Ordinary and Honorary Fellows of the Institute:

Honorary Fellows: Prof. R. K. Asundi; K. P. Basu; Prof. K. P. Chattopadhyaya; C. R. Das Gupta; Dr. S. Ghosh; Lt.-Col. S. Greval; Mr. S. Gupta; Dr. P. V. K. Iyer; A. N. Khosla; Dr. K. B. Lal; Prof. Shri Anand; Prof. S. R. Narayan Rao; Mr. K. S. Nayak; Prof. N. K. Sen; Sir M. Visvesvaraya.

Honorary Fellows: Sir Alexander Fleming, N.L. (England); Prof. Richard Kuhn, N.L. (Germany); Prof. Hermann Joseph Muller, N.L. (U.S.A.); Prof. Selman A. Waksman (U.S.A.).

Society of Plant Morphologists

During the recent Indian Science Congress held at the Indian Institute of Science, Bangalore, a group of Botanists interested in Plant Morphology met on January 4th, 1951 and decided to form a Society of Plant Morphologists. It was resolved that the Society must start a journal devoted to all aspects of Plant Morphology from Algae to Angiosperms and run it on an International basis. It was unanimously decided that the amount for Life Membership in the above Society should be Rs. 200 and the annual subscription Rs. 20. Pending formal election of office-bearers sometime next year it was arranged that Prof. P. Maheshwari, Professor of Botany of the Delhi University, should be requested to act as the Convener of the Society and Editor of the Journal. All those interested in Plant Morphology are requested to join the Society and send the subscription to the Convener.

Indian Standards Institution

The Third Annual Report of the Indian Standards Institution which has just been

published reveals that during the year the Institution received increased support both from Government and industry. Its membership rose from 475 to 563 and the number of Committee Members went up from 1,600 to 2,200. The number of Sectional and Sub-Committees is reported to be nearly 240 as against 190 in the previous year.

Particular mention has been made in the report of the recommendation of the special committee on weights and measures and the scheme of certification marking now under consideration of the Government of India.

The certification marking scheme is a measure intended to encourage standardisation of industrial products, which should also convey to the consuming public a guarantee of quality in respect of goods to which the mark is applied. In this connection a draft Bill, which was earlier submitted to the Government of India, is now under consideration and it is expected to be introduced in the next session of Parliament.

Other subjects under consideration, cover a wide range of engineering, textile and chemical items including cement and concrete, ferrous and non-ferrous metals, electrical plant, conductors and accessories, timber, hardware, refractories, radio equipment, batteries, cotton yarn and cloth, jute, wool, textile stores, national flag, rayon, organic and inorganic heavy chemicals, fine chemicals, lubricants, rubber products, paints and allied products, bitumen and tar, essential oils, inks, etc. The library of the Institution has accessioned 3,000 new specifications during the year, the total number of standard specifications in the library now being more than 10,000.

In the field of international co-operation, the Report recalls the sessions of the International Organisation for Standardisation (I.S.O.) Technical Committees for shellac and mica, commodities which, on an average, bring in foreign exchange to the extent of Rs. 15 crores every year. The sessions led to agreement on a majority of important points regarding international standardisation of shellac and mica.

Copies of the Report can be had from the Secretary (Administration), Indian Standards Institution, 19, University Road, Civil Lines, Delhi-8.

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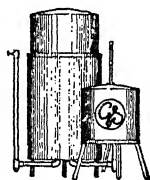


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THE LUMINESCENCE OF DIAMOND—III

SIR C. V. RAMAN

1. THE ELECTRONIC EMISSION SPECTRA

AS was remarked in the first article of the series, the emission band at $\lambda 4156$ discovered by C. Ramaswamy in the year 1930 plays the leading role in the blue luminescence of diamond, while the band at $\lambda 5038$ studied later by Dr. Nayar and by Miss Mani plays an analogous role in respect of the green luminescence. These bands sharpen when the diamond is held at liquid air temperature and shift to $\lambda 4152$ and $\lambda 5032$ respectively. The $\lambda 4152$ emission also then appears resolved into a doublet, the width and separation of the components varying considerably with the specimen under study. In particular, the doublet is narrow for the diamonds which exhibit the blue luminescence feebly, a circumstance which is favourable for a satisfactory resolution of the associated vibrational spectrum into its discrete components. Absorption

bands are also observed at $\lambda 4152$ and $\lambda 5032$ in the spectrum of white light transmitted by the respective diamonds, the strength of such absorption varying *pari passu* with the intensity of the corresponding emission. Hence, one is justified in ascribing them to electronic transitions in the crystal lattice. Where there is an apparent lack of correspondence between the strength of the absorption and of the emission, there is evidence for the existence of self-reversal or other cause affecting the emission intensity.

The investigations of Dr. Nayar and of Miss Mani have also shown that $\lambda 4152$ and $\lambda 5032$ are by no means the only electronic transitions recorded in the luminescence spectra, though these stand out by reason of their special intensity and their association with vibrational transitions in the lattice. Lines

appearing strongly both in emission and absorption have been observed at λ 4189, 4197, 4206, 4907, 4959 and 5359. A fairly strong line at λ 5758 and numerous others which are less intense have also been recorded in the emission spectra of various diamonds but have not so far been detected in absorption. The electronic emission lines may be divided broadly into two groups, *viz.*, those that appear along with the emission at λ 4152 and the rest with that at λ 5032. They are observed respectively with the diamonds exhibiting these two types of luminescence.

The electronic line at λ 4156 present in the blue luminescence spectrum sharpens and increases in peak intensity when the diamond is cooled down. *Per contra*, it decreases in peak intensity when the diamond is heated up, until finally at 350°C . it merges into a continuous background and ceases to be visible. Its integrated intensity has been investigated by Chandrasekharan and found to remain unaltered over a wide range of temperature. Miss Mani's investigations have shown that the other electronic lines likewise shift towards smaller wave-lengths and sharpen when the diamond is cooled down to liquid air temperature. The shift in wave numbers in the

at λ 1060, and the minor term with an absorption wave-length at λ 1750. The actually observed absorption in the ultra-violet, however, extends further towards greater wave-lengths. Diamonds of the non-luminescent type show a complete cut-off for wave-lengths less than λ 2250, while the best specimens of this class exhibit a complete transparency in the visible and near ultra-violet regions of the spectrum. Diamonds which exhibit luminescence, however, show a different behaviour. When the thickness of the plate is reduced sufficiently, the observed transmission extends down to λ 2250. There is, however, a strong absorption at greater wave-lengths, and indeed with the largest thicknesses, a complete cut-off is observed extending to λ 4152, and feebler absorption bands are noticed at even greater wave-lengths. These features are exhibited in Figs. 1 and 2 taken from a paper by K. G. Ramanathan.

In moderate thicknesses, however, blue-luminescent diamonds transmit wave-lengths greater than λ 3000 quite freely with the exception of certain absorption lines noticed in the region between λ 3500 and λ 3000, and the vibrational bands associated with the λ 4152 electronic transition.

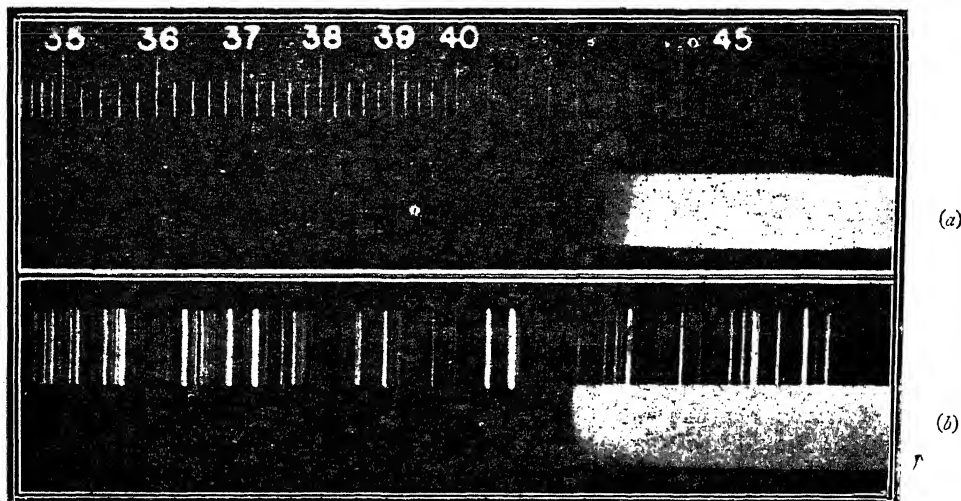


FIG. 1

Absorption of Visible Light by Thick Diamond: (a) At Room Temperature; (b) At Liquid Air Temperature.

various cases is found to be of the same order of magnitude and roughly proportional to the respective frequencies.

2. THE ELECTRONIC ABSORPTION SPECTRA

The refractive indices of diamond fit very well into a dispersion formula containing two terms, the major term indicating an absorption

Some 25 such absorption lines of the first kind can be seen in Fig. 3 which is reproduced from a paper by Dr. Nayar. To record them successfully, it is necessary to hold the diamond at liquid air temperature and to adjust the thickness of diamond traversed as well as the photographic exposure suitably.

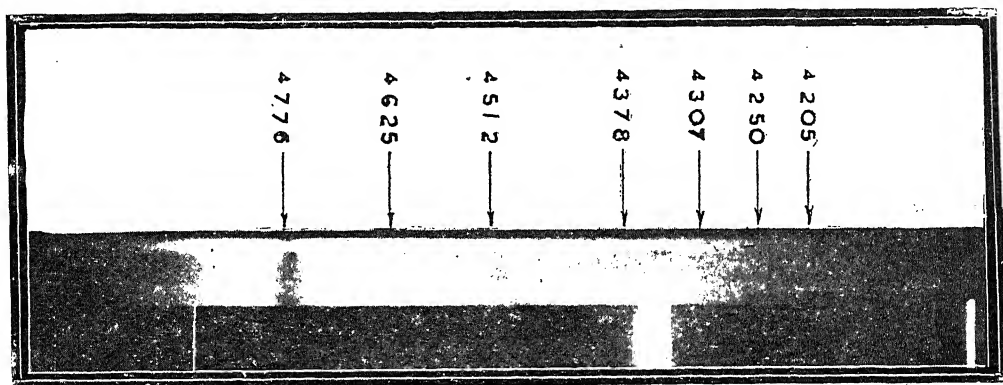


FIG. 2

Absorption of Visible Light by Thick Diamond under High Dispersion.

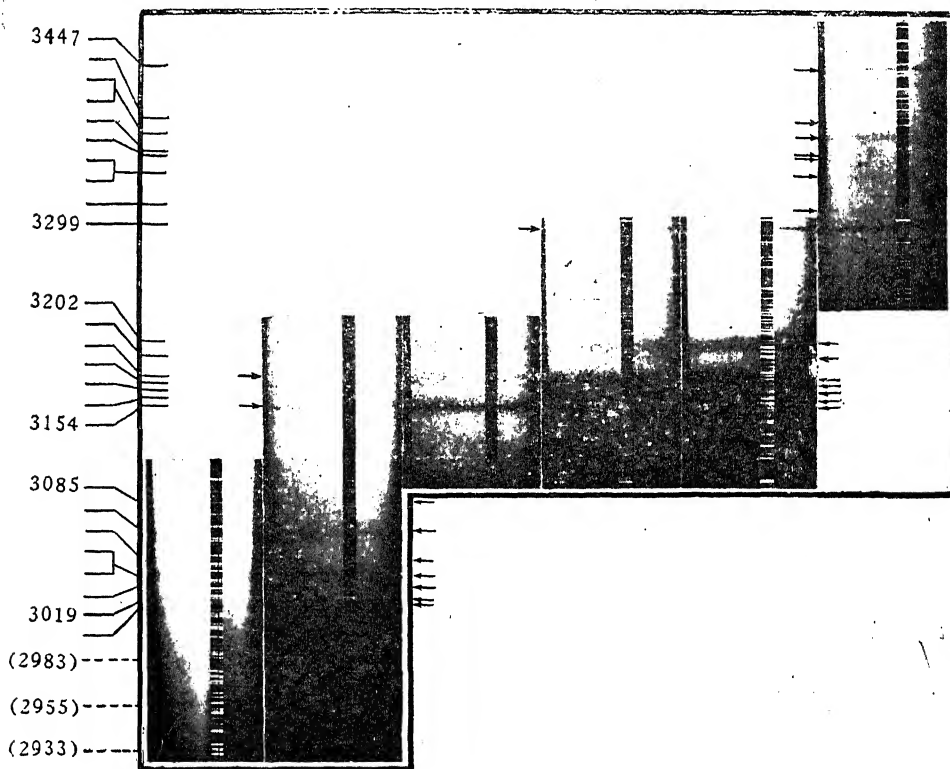


FIG. 3

Absorption Lines in the Ultra-Violet.

Ordinarily, a diamond of the blue-luminescent class should be less than a millimeter thick to show any transmission for wave-lengths less than $\lambda 3000$. Very thin diamonds of the same variety exhibit a series of sharply-defined absorption lines in the wave-length region between $\lambda 2370$ and $\lambda 2240$. These are shown in

Fig. 4 reproduced from a paper by K. G. Ramanathan.

It is noteworthy that a precisely similar set of absorption lines is observed also in the ultra-violet transmission of green-luminescent diamond, but can then be seen with moderate thicknesses of the material.

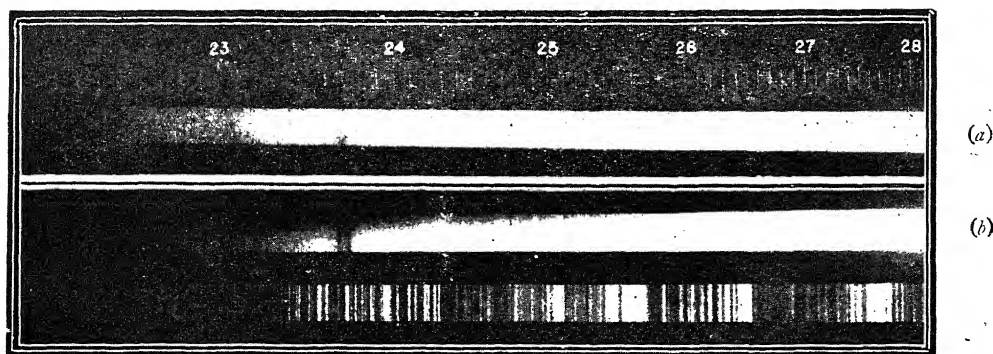


FIG. 4

Ultra-Violet Absorption Spectrum of Thin Blue-Fluorescent Diamond: (a) At Room Temperature and (b) Liquid Air Temperature.

It should be emphasised that the absorption spectra exhibited in Figs. 3 and 4 stand on a different footing from those mentioned in the preceding section and those shown in Figs. 1 and 2. They do not appear as emission lines, and their strength is not directly related to the intensity of luminescence. Indeed, the absorption lines seen in the vicinity of $\lambda 3000$ become weak and diffuse and the transparency extends further into the ultra-violet in the case of strongly blue-luminescent diamonds, as was first observed by Sunanda Bai.

3. THE INFRA-RED ACTIVITY OF DIAMOND

Polished cleavage plates are particularly suitable for quantitative studies on infra-red absorption. The results obtained by K. G. Ramanathan with a whole series of such plates are highly significant in relation to our pre-

sent subject. No important differences are observed as between different diamonds in the infra-red activity in the spectral region between 1400 and 2800 cm^{-1} which covers the octaves and combinations of the fundamental vibration frequencies. There are, however, great differences in behaviour in the spectral region between 700 and 1400 cm^{-1} which covers the first-order vibration frequencies. The diamonds which are non-luminescent are completely transparent in the latter region. On the other hand, the non-birefringent and weakly blue-luminescent diamonds show a strong activity in the latter region, and the absorption-curves exhibit a series of peaks exhibiting a resolution of the vibration spectrum into distinct components (see Fig. 5). Green-luminescent diamonds show an inter-

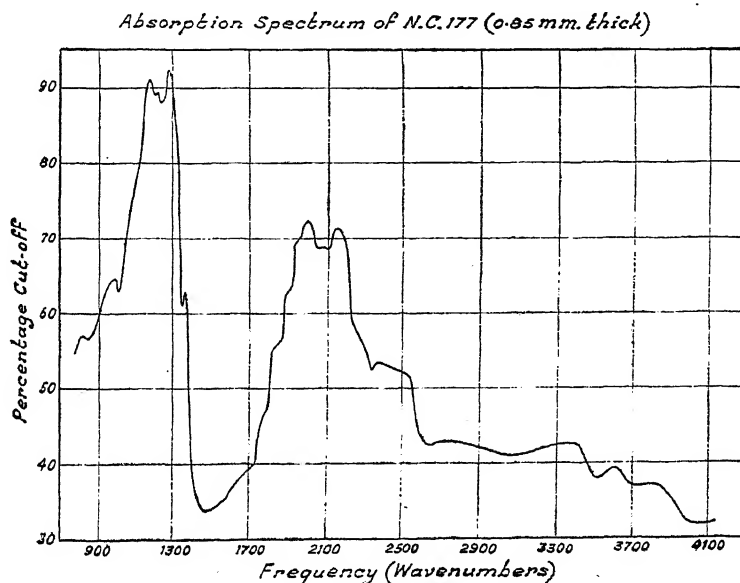


FIG. 5

Infra-Red Absorption Spectrum of Blue-Fluorescent Diamond.

behaviour, such as would result from successively through two plates of ap- thickness belonging respectively to and non-active types (see Fig. 6). blue-luminescent diamonds are found an infra-red activity which is dis- than in the case of diamonds with luminescence. The character of the on-curve also shows minor variations nying the changes in the colour and of the luminescence.

activity indicates that the electronic structure of the non-luminescent diamond has the highest or Oh type of symmetry, while the electronic structure of the blue-luminescent diamonds possesses only the lower or Td type of symmetry.

4. THE ORIGIN OF THE LUMINESCENCE

The experimental facts already described do not permit us to accept the belief formerly entertained that the luminescence of diamond arises from the presence of chemical impuri-

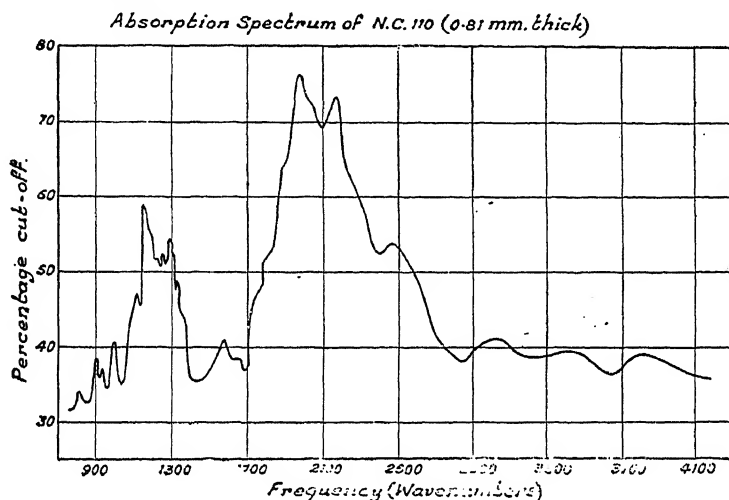


FIG. 6

Infra-Red Absorption Spectrum of Green-Fluorescent Diamond.

diamonds which show the first-order activity most strongly are those which make the nearest approach to ideal perfection of crystal structure as shown by their behaviour from birefringence and their X-ray results. *Per contra*, the diamonds which do not show the first-order activity are those which exhibit the largest departure from ideality indicated by such tests. In these circumstances it is clearly not possible to ascribe the activity exhibited by the former class of diamonds to structural imperfections or other circumstances. We are, in fact, obliged to recognize that the difference in behaviour connotes a fundamental difference in structure. The nature of such difference is not known from well-established spectroscopic results, according to which the absence or presence of first-order infra-red activity in a diamond of the cubic class depends on whether the symmetry of the crystal does or does not conform to centres of symmetry. In other words, the behaviour in respect of infra-red

ties. They also serve to exclude the alternative hypothesis that the luminescence is activated by extraneous impurities. As early as 1941, Dr. Nayar suggested that the origin of the blue luminescence studied by him should be sought for in the departure of the crystal structure from ideal perfection. While this suggestion contains an element of truth, the results of subsequent investigations with a wider range of material show that it is not by itself sufficient to cover the facts. It does not, for instance, explain why diamonds which, as judged by optical and X-ray tests, show structural imperfections of the crystal in the highest degree, are precisely those which are non-luminescent. Neither does it account for the green type of luminescence and for the relationship between luminescence and birefringence which has been so clearly established. We are thus forced to look a little deeper to reach a clear understanding of the array of facts revealed by the Bangalore investigations.

(To be continued)

DR. M. S. KRISHNAN

SCIENTISTS all over India will welcome the news of the appointment of Dr. M. S. Krishnan, M.A., Ph.D., A.R.C.S., F.N.I., as Director of the Geological Survey of India. Dr. Krishnan is the first Indian to become the Head of this important Department of the Government of India.

Born in 1898 at Maharajapuram, Tanjore District, Dr. Krishnan has had a brilliant academic career. After taking his Honours degree in Geology with distinction from the Madras Presidency College in 1919, he worked as a Demonstrator for two years in the same college. He then went to the Imperial College of Science and Technology, and in 1923, was awarded the Ph.D. degree of the London University.

Dr. Krishnan joined the Geological Survey of India in 1924 as an Assistant Superintendent and did a considerable amount of field work in the Orissa States of Gangpur, Keonjhar, etc. Later, under his direction, many mineral deposits were investigated, and systematic geological mapping commenced in several districts of the Madras Presidency.

From 1933 to 1935, he was Professor of Geology at the Presidency College, Calcutta, which post he held along with that of the Curator (now styled Petrologist) in the Geological Survey.

In 1935, he went to Great Britain, United States of America, and Canada, and visited several important centres of Mining and Geology. On his return in 1936, he was appointed a Member of the Coal Mining Committee constituted by the Government of India.

Dr. Krishnan became a Superintending Geolo-

gist in 1945, and in 1946 visited England as Official Delegate to the Royal Society Entomological Scientific Conference. In 1947, he was deputed to Europe and America to make a special study of the methods of investigation of rare minerals. In 1949, he attended, at Lake Success, New York, the United Nations Scientific Conference on the Conservation and Utilisation of Resources as a Member of the Indian Delegation.

He was President of the Geology Section of the Indian Science Congress in 1935. He is a Fellow or Member of many learned societies of the world, chief among which are the Indian Academy of Sciences, National Institute of Sciences of India, National Academy of Sciences of India, Mining, Geological and Metallurgical Institute of India, Geological, Mining and Metallurgical Society of India, Indian Society of Soil Science, Indian Ceramic Society, Geological Society of London, American Institute of Mining and Metallurgical Engineers, Canadian Institute of Mining and Metallurgy, Society of Economic Geologists of America, and Mineralogical Societies of America, England, France, Germany and Switzerland.

Dr. Krishnan has published numerous valuable papers on the mineralogy, petrology and economic geology of many parts of India.

The Geological Survey of India has completed one hundred years of its life, and it is most fitting that at the beginning of its second century, its activities should be glorified by such an eminent geologist as Dr. Krishnan who combines wide administrative and organizational experience with intense love for scientific research. We wish him a very successful tenure of office.

MULTI-PURPOSE FOOD

THE California Institute of Technology has developed a Multi-Purpose Food (M.P.F.) to provide at minimum cost (3 cents) and in minimum bulk (2 oz.) a highly nourishing, palatable, protein food, fortified with vitamins and minerals. The non-profit "Meals for Millions Foundations" introduced M.P.F. to the world and more than 16,000,000 meals have been distributed by relief agencies operating in over 50 countries including India.

Since the Foundation is finding it difficult to export this food freely, it is interested in having a similar type of food developed in India

from indigenous materials for use in times of emergency. This Foundation and the Watu Foundation have accordingly sponsored a research project, in the Food Technology Section of the Indian Institute of Science, Bangalore, for exploring the possibility of utilising abundantly available oilcakes for this purpose. The nutritive value of the preparations prepared in the section will be determined by feeding experiments and compared with that of M.P.F., a ton of which has been donated by the two Foundations.

TOPOLOGICAL METHODS IN ANALYSIS

IN his Presidential Address to the Mathematics Section of the 38th Indian Science Congress, Dr. Racine gave a survey of the methods developed by J. Schauder and J. Leray for the boundary value problems associated with elliptic partial differential equations of the second order. The first linear problems to be studied were those of determining harmonic functions satisfying the boundary conditions of a Dirichlet- or Neumann-problem (D- or N-problem). The D-problem in this case may be solved, under very general conditions, by the method of "balayage" due to H. Poincaré. Such a method has not been adapted so far to the general elliptic equation. By constructing appropriate Green's functions, Giraud established the equivalence of the general D- and N-problems to certain integral equations and thus made available the method of potentials and integral equations as in the classical case of the Laplace equation. Giraud also developed a method of successive approximation for treating non-linear problems. Schauder's method of solution of linear elliptic problems is extremely original and deduces an existence-theorem from an "*a priori approximation*" of the solution. Generally it excludes the possibility of any construction and gives only existence, not uniqueness, theorems. He makes use of refined forms of certain well-known inequalities in the theory of Newtonian potentials and a process of successive approximation starting from the solution for the Laplace equation. Schauder's most important contribution to the theory of partial differential equations of mathematical physics is his new method of solving non-linear problems. His first investigations deal with extensions to function-spaces

of the celebrated "fixed-point-theorem" of L. E. J. Brouwer. There exists an equivalence between a given D-problem and the problem of finding the fixed points of the transformation $u = U(u)$, where U is a functional operator which maps a certain function-space V or a subset of it onto itself. Schauder generalised Brouwer's fixed-point-theorem to topological spaces, but he was obliged to restrict himself to metric vectorial spaces, in particular, Banach spaces. He developed also a second method, based upon his generalisation of Brouwer's theorem on the "invariance of the domain" to Banach spaces in which he defined a weak topology in addition to the strong topology. Leray had utilised a topological invariant: "the degree of a transformation". This notion, due to Brouwer, was generalised to function-spaces by Leray and Schauder, who were thus enabled to develop a general method of proving existence-theorems in the theory of functional equations. The method of Leray and Schauder may be applied to the most general non-linear problems under certain conditions. It has been very successful in the hydrodynamical theories of viscous fluids and of wakes. Recently Leray has developed the theory of a topological invariant attached to the continuous mappings of a topological space into itself. It is valid in compact Hausdorff spaces. His new theory, based essentially on the notion of the "total index" of a transformation with respect to an open set, has enabled him to arrive at a very powerful synthesis of his and Schauder's previous results and to generalise the same considerably.

V. R. T.

GLEEP

THE Graphite Low Energy Experimental Pile (Gleep) at Harwell, was constructed to meet two main requirements: the first was for a pile able to work at as high a power as it is possible without introducing elaborate cooling arrangements. This high power was needed for the production of the radio-active forms of elements which are proving of immense value in many branches of medical and scientific research: the second was to compare, for scientific purposes, the ways in which different elements absorb slow neutrons, the type of angular particle emitted by the pile.

This relatively small experimental pile requires 12 tons of uranium and a further 21 tons of oxide of uranium. In addition, the pile contains over 500 tons of graphite in a very pure state. It has an output of 100 kilowatts.

By providing radio-active forms of natural elements for research purposes, the Gleep has already proved immensely valuable. In addition, the experience gained in operating this experimental pile during the last three years has proved an invaluable aid to the design of larger piles suitable for providing energy on an industrial scale.

—By courtesy to B.I.S.

DOPPLER EFFECT IN LIGHT-SCATTERING*

THE light scattered by all states of matter exhibit a Doppler shift of frequency owing to the thermal motion of the molecules. The effect with gases is readily calculated from the Maxwellian law of distribution of velocities, and the author's experiments on H_2 , O_2 , N_2 and CO_2 give results in agreement with theory. The diffusion of light by crystals has been studied by Raman and others. In the theory due to Brillouin, it is ascribed to a coherent reflection of light by the elastic waves of thermal origin in the crystal. In general, there are three types of elastic waves in any direction, and two possible velocities for the light waves in the incident and scattered directions, so that 12 pairs of Doppler components should be observable, as was recently pointed out by Chandrasekharan. Gross, Raman and Venkateswaran, and Sibaiya made interferometric studies, while Krishnan and Chandrasekharan have recently recorded the Doppler components with crystals using a three-metre spectrograph.

The molecular scattering of light by liquids was shown by Raman to agree with the Einstein-Smoluchowski formula for density scattering. However, the observations of Gross and of Rao that the scattered light contains Doppler-shifted components called for a revision of the concepts regarding the structure of liquids. The author obtained excellent detail in the patterns by the use of a zinc arc developed by him which emitted radiations free from satellites. It was

found that there are (1) a depolarised central component, (2) well-polarised Brillouin components on either side, (3) a diffuse band between the two and (4) a continuous background. These observations are in fair agreement with Frenkel's 'hole theory' of liquids, in which a liquid is supposed to be more akin to a solid than to a gas. The theory however fails to account for the dependence of the intensity of the central component, the continuum and the Brillouin components on the viscosity of the liquid.

The hypersonic velocities (*i.e.*, for frequencies of the order of 10^9) in 22 liquids of low viscosity were calculated from the shift of the Brillouin components and showed no appreciable difference from the supersonic velocities. However, in the case of glycerine and castor oil, the hypersonic velocity was far greater than the supersonic velocity. This shows that at high frequencies of the order of 10^{10} sec⁻¹, glycerine behaves like a rigid solid. The relaxation time deduced in this way is in reasonable agreement with that calculated from

Maxwell's formula $\tau = \frac{\eta}{n}$. Recently, R. S.

Krishnan has been able to record the Doppler components in fused quartz, which may be considered to be a supercooled liquid with a large relaxation time. Comparative studies of light-scattering in solids, liquids and gases will ultimately lead to valuable information regarding the space distribution and orientation as well as the kinetics of molecules in different states of aggregation. In this field of research as in Raman effect, India's contribution has been quite significant.

* Abstract of Presidential Address delivered to Section of Physics, by Dr. C. S. Venkateswaran at the 38th Indian Science Congress.

THE BEARING OF GEOLOGY ON MULTI-PURPOSE PROJECTS*

IT is with a background of geologically young active movements, and sharp regional and seasonal variations in climate, that we have to view the construction of the major multi-purpose projects. The geologist who is well versed with the broader issues of regional tectonics, earthquakes, soil erosion and water conservation must play a major part in the planning of such projects. Thus the occurrence of earthquakes have to be taken into serious consideration.

Earthquakes produce landslips in the mountainous regions. By the determinations, made by the U.S. Coast and Geodetic Survey, of the epicentre of the recent August, (1950) Earthquake, it is inferred that the Teesta landslips are related to the effect of an abnormally wet monsoon on hill slopes and not to the Assam Earthquake. But at the same time we have to bear in mind that even the mildest shock of the earthquake acts as a trigger and might initiate slips in loose ground.

The secular changes in elevation of the Himalayas also play an important part in the construction of multi-purpose projects. The slow secular movements which are taking place

* Abstract of Presidential Address, by Dr. J. B. Auden, Sc.D., F.N.I., to the Section of Geology and Geography, during the 38th Session of the Indian Science Congress, 1951.

in the orogenic zone both vertically and horizontally have yet to be confirmed by instrumental observations.

The study of the dam sites like Dhiangarh, Larji and Daher within the Himalayan region has shown that a number of large projected structures lie close to major thrust planes. In all such cases it is essential to decide to what extent proximity to the major thrust planes is likely to be a dangerous feature affecting the stability of structures. The general impression is that a structure of large dimensions can be designed as a safe unit against major shocks. The Himalayan Valleys, notwithstanding their proximity in certain parts of the range to seismic centres, are permissible locations for the construction of dams.

The Peninsular structures are quite different. The Peninsula has not undergone the recent orogenic movements of the montana zone.

Many of the dam sites have presented foundation defects and these require engineering treatment. The main feature with which we are concerned happen to be weathering and the consequences of faulting and shearing.

The generalised text-book statements that the strike of the bedded rocks should be parallel to the axis of the dam must not be mechanically and uncritically followed. On the other hand, studies of the Indian dam sites have clearly shown that each dam has to be judged on its own merits. Also we have to bear in mind that geological terrains can be radically different, and that all projects must be assessed by a comprehensive study of tectonics, seismicity, siltation and economics. Our conclusions must not be based merely on problems solved elsewhere as they may not serve the best interests of our country.

M. G. C. NAIDU.

CHEMOTHERAPY OF MALARIA—A FUNDAMENTAL APPROACH

CONTROL of malaria by prophylaxis and by chemotherapy has so far been our stumbling block. No satisfactory prophylactic drug has yet been announced and the so-called curative drugs have been found to be ineffective even under optimum conditions in all species of malaria. Great advances have recently been made and the discovery of the exo-erythrocytic forms in the liver of the primates and humans should be a great help in the experimental approach of the problem. But our chief difficulty in the interpretation of the anti-malarial toxicological data lies in the lack of precise knowledge as to the actual site of drug interaction in the parasite. If we could determine the relationship between the drug receptor group in the parasite and the external drug phase, we would be in a much better position than we are at present to collaborate with the chemists in the synthesis of new and effective compounds.

It is with this end in view, study in the physiology and biochemistry of the malarial parasites, both *in vivo* and *in vitro*, is being carried out in the Pharmacology Laboratory at the Indian Institute of Science, Bangalore.

The present knowledge of the nutritional requirements of malaria parasite, its respiratory system, and enzyme make-up is very meagre. Some progress in the direction of *in vitro* culture of the forms of malaria parasite characteristic of infection in vertebrate host has been made in this laboratory with relatively crude cultures and attempts are being made at a fine analysis of the basic nutritional need of *P. gallinaceum*. Correlating all these data, it is the aim of the laboratory to find new chemotherapeutic agents for malaria by testing analogues of metabolites essential for blood forms.

Nutritional studies of blood forms of malaria parasites *in vitro* will alone not solve the problem. Cultures of exo-erythrocytic forms are perhaps more likely to provide more information than the culture of blood forms in nutritional studies designed to lead towards curative anti-malaria's, but precise analysis of the parasites' nutritional requirements in their complex extra-cellular environment would present very great difficulty. Attempts are also being made in this direction because the cardinal requirement of anti-malarial chemotherapy is to find a substance which would attack the parasite in its exo-erythrocytic form.

LETTERS TO THE EDITOR

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UNIT CELL AND SPACE-GROUP OF
SODIUM TARTRATE $\text{Na}_2\text{C}_4\text{H}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$

SODIUM TARTRATE was crystallised from aqueous solution at room temperature. The crystals, belonging to the orthorhombic system (point-group 222), were needle-shaped, being elongated along the c-axis. Rotation photographs taken about the a-, b- and c-axes yielded the following values for the unit cell dimensions: $a = 11.5 \text{ \AA}$, $b = 14.7 \text{ \AA}$, $c = 4.95 \text{ \AA}$. From high order reflections in the zero-level Weissenberg patterns about the c- and b-axes, the unit translations were found more accurately to be

$$a = 11.49 \text{ \AA}, b = 14.67 \text{ \AA}, c = 4.97 \text{ \AA}$$

The ratio $a : b : c$ works out to be $0.782 : 1 : 0.338$ agreeing well with the values $0.779 : 1 : 0.335$ deduced from morphological studies quoted by Groth.¹ Assuming the density to be 1.818 ,² the number of molecules in the unit cell is calculated to be 3.986 , i.e., $Z = 4$.

Zero-level Weissenberg patterns about c- and b- axes showed the following extinctions: orders $h00$, $0k0$, $00l$ are absent if h , k , l are odd respectively. The orthorhombic space-group $P2_12_12_1$ is thus the only possibility,

which is compatible with the point-group 222 deduced from the external form.

(MRS.) AHALYA RADHAKRISHNAN,
G. N. RAMACHANDRAN.

Department of Physics,
Indian Institute of Science,
Bangalore-3,
January 12, 1951.

1. Groth, P., *Chemische Krystallographie*, 3, 332.
2. Lange, A., *Handb. of Chemistry*, V Edn., 1944, 244.

TESTING IMAGINATION BY
PROJECTIVE TECHNIQUE

Use of Ink-blot tests has of late become widely popular as an effective means of clinical and normal personality diagnosis. The type that is commonly employed, however, is the passive interpretative, viz., inviting the testee to 'see' ideas in the given blot. The Psychological Laboratory of the Indian Institute of Science, Bangalore, experimented upon variant types, the purpose being to get at the most effective type. Out of one hundred chance blots, five blots were selected by process of standardisation; those blots were manipulated by way of

taking out a large part from each blot and of denuding the blots of their colour; the former were called Part-blots; and the latter Empty-blots. The original blots were whole-filled. These were also emptied of their colour. Thus four varieties of blots, viz., whole-filled (WF), whole-empty (WE), part-filled (PF), and part-empty (PE), were administered in two ways, passive interpretation (I) and active projection (P). The former is the familiar way of asking the subject to note down what ideas occurred to him as a consequence of attending to the blot. The latter was the new technique of asking the subject to create ideas on the basis of the given part blots, either whole or empty, manipulating the blot by addition of lines, dots, shades, etc. A difference was thus introduced in the structuredness of the field of perception. Thus a series of six types was obtained: WFI, WEI, PFI, PEI, PFP and PEP.

The purpose of the study was to determine the precise role of the various ways of structuring the blot that plays in occasioning imagination.

For a preliminary study, ten adolescent males of the High School Standard, their ages ranging between 14 and 18 years, were chosen at random and 400 observations were made at different intervals in order to minimise the lag effect, and the number of responses in each case within the specified time (5 min) were recorded. The scores were statistically treated by the analysis of variance method. The variance between the responses was found to be highly significant, indicating thereby that the null hypothesis (viz., the various methods of utilizing the blot-material have the same influence over the subject in so far as the number of interpretation within a given time is concerned) is probably untrue. The variation in the number of responses arises from certain significant variations in the responses themselves. The critical difference in the totals of the responses was calculated to be 27.026; and it was discovered that the responses involving projective technique, in no case, exceeded in number those not involving projective technique. But this conclusion is tentative and subject to confirmation by a wider sample.

Out of the several modes, WEI seems most fruitful; WF in both I and P are significantly inferior to WE. Among the part blots, PFI seems to be the best and its superiority over PEP and PFP is significant, but not over PEI. In effect, whole-empty appears the best in occasioning imagination out of the six modes,

taking into consideration the quantitative aspect of responses only.

Sec. of Social Sciences, N. S. N. SASTRY.
Indian Inst. of Science, S. K. R. RAO.
Bangalore,
January 17, 1951.

"PARTITION PHOSPHORUS" IN BLOOD OF CHICKS DURING INFEC- TION WITH *P. GALLINACEUM*

BOVARNICK, *et al.*¹ during their study on the metabolism of *P. lophurae* reported that the analyses of changes in total labile and inorganic phosphorus in parasite reaction mixtures under various conditions indicate that 100 minute incubation in buffer without substrate leads to an increase in the inorganic phosphorus and to decrease in organic and labile phosphorus. Significant increase has also been observed to occur in nucleic acid P, phospholipid P and 15-minute acid hydrolysable P in red blood cells during the growth of *P. knowlesi* in monkeys.^{2,3}

In an attempt to study the metabolism of the malarial parasites, investigations into certain chemical and metabolic properties of blood of normal and infected hosts were undertaken. In this note report is only made of the changes in various forms of phosphorus occurring in the blood of chicks infected with *P. gallinaceum*. During the course of investigations the phosphorus content of the blood of the chicks was noted to be much greater than that of mammals, the inorganic phosphorus comprising only a small fraction of the whole.

Experimental:—Blood from donor chicks was drawn by cardiac puncture and diluted with 2% citrated saline so that 0.1 ml. contained approximately 10^6 parasitised red blood cells. Inoculations with infected blood were made intramuscularly and the course of infection was followed by taking blood smears regularly and staining with Leishmann stain. Parasite counts are expressed as percentage by actually counting the number of parasitised cells in 500 r.b.c.

The estimations of partition phosphorus are carried out by methods described by King.⁴ Only in the case of ester phosphorus the method was slightly modified, thus: 0.5 ml. of blood was added dropwise with shaking to 5 ml. of a mixture of 90 parts of alcohol and 10 parts of ether in a pyrex tube marked at 10 ml. The mixture was refluxed on a water-bath for 10 min., cooled and made up to 10 ml. The mixture was filtered as quickly as possible. 5 ml. of the filtrate was carefully evaporated to dry-

Period	Before infection	Pre-patent period	< 5% parasitemia	10-15% parasitemia	> 30% parasitemia
Total P ..	101.8 \pm 3.2 mg./100 ml.	91.2 mg./100 ml.	80.8 mg./100 ml.	73.8 mg./100 ml.	73.3 mg./100 ml.
Ester P ..	31.35 \pm 2.5 "	28.3 "	20.2 "	17.5 "	18.3 "
Inorg. P ..	4.7 \pm 0.27 "	4.3 "	4.4 "	5.4 "	5.5 "
Lipo. P ..	18.0 \pm 0.92 "	12.4 "	16.9 "	17.8 "	17.7 "

ness. The phosphate was estimated by digestion with perchloric acid as in the case of total acid soluble P. The experiments were conducted on 12 white leg-horn chicks, 3-4 weeks old. The analyses were done in duplicate and the results obtained are given in the above table.

As the period of infection lengthened there was a steady decrease in the total P. It was significant that the phospholipid attained a very low value during the prepatent period and increased again almost to the normal value with the appearance of the parasites in the blood stream. The lowering of the total P during infection is seen to be mainly due to the decrease in organic bound P. Reduction in the number of cells alone does not explain fully the decrease in ester P. Presumably the metabolism of the parasite is also intimately involved.

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STUDIES IN ION EXCHANGE.

Part I. Equilibrium Studies of Three Synthetic Cation Exchange Resins

THE three synthetic cation exchange resins used were Amberlite IR-100, Amberlite IR-105 and Amberlite IR-120, manufactured by Resinous Products Division, Rohm and Haas Co., Philadelphia, Pa.

Equilibrium studies, from the point of view of constructing the pH—m.eq. cation uptake/gm. air-dried resin-titration curves¹ and determining the available replaceable hydrogen have been reported for Amberlite IR-100²⁻⁴ and Amberlite IR-105.⁵ However, to our knowledge, no such studies are available for Amberlite IR-120. Hence we have carried out such studies for all the three resins under similar conditions. The resins were used in the air-dried hydrogen form.

Figs. 1 and 2 give the pH titration curves for Amberlite IR-100 and Amberlite IR-105,

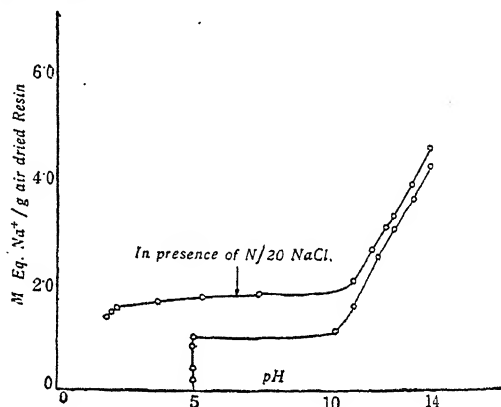


FIG. 1. Titration Curves of Resin Amberlite IR-100 H

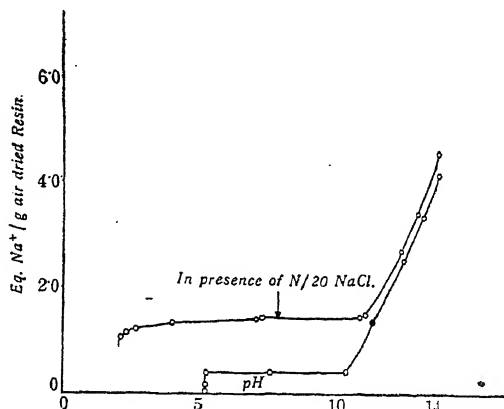


FIG. 2. Titration Curves of Amberlite IR-105 H.

respectively in the presence and absence of N/20 sodium chloride. The curves indicate that up to pH 10-10.5 the active groups are of sulphonic type and above this, groups of hydroxyl type are also active. Fig. 3 shows the pH titration curves for Amberlite IR-120, with and without N/20 sodium chloride. From the curves, it can be concluded that in the presence of salt, the resin is truly unifunctional, the ion active groups being of sulphonic type. But, in the absence of salt, the activity of all these groups is not the same.

The pH titration curves for the three resins

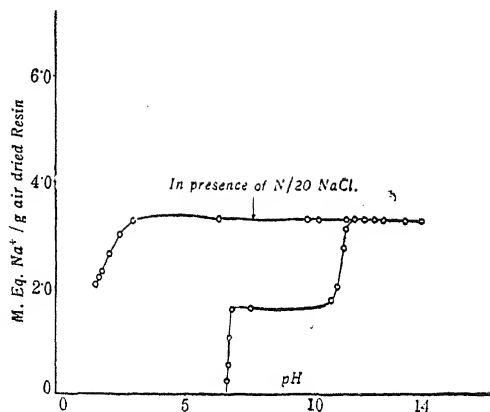


FIG. 3. Titration Curves of Amberlite IR-120 H.

also show that the excess of cation (here Na^+) increases the cation uptake of the resin at the same pH, which should be due to increased $\frac{\text{Na}^+}{\text{H}^+}$ ratio, according to the Mass Action Law.

The available replacable hydrogen was determined by the following methods:—

(a) pH—m.eq. cation uptake per gm. air-dried resin—titration curve (at pH 6-7).

(b) Limiting exchange value with BaCl_2 solution.²

(c) Ash determination in barium salt of the resin.²

Table I give the results obtained.

TABLE I

Resin	Moisture content of air dried resin in hydrogen form	$10^3 \times$ m.eq. available replacable hydrogen per gm. fully dried resin by method		
		(a)	(b)	(c)
Amberlite IR-100	21.1%	1.71	1.55	1.67
Amberlite IR-105	29.2%	2.30	2.62	2.60
Amberlite IR-120	28.0%	4.58	4.62	4.63

Further work is in progress, and will be published shortly elsewhere.

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IONOPHORETIC SEPARATION OF METHIONINE

ALTHOUGH the dl form of this amino acid has been prepared synthetically and has been shown to have the same physiological activity as the natural isomer, numerous investigations have been carried out to isolate it from protein hydrolysates.^{1,2,3} Unfortunately, however, none of the isolation methods employed optimum conditions given by Toennis and Kolb,⁴ for the complete precipitation of methionine. This precipitation has been found to be usually complete in the absence of chloride ions, the dicarboxylic and diamino acids, at a neutral pH and in the presence of alcohol. It occurred to us, therefore, that these conditions could best be fulfilled by adoption of the ionophoretic procedure for protein hydrolysates, whereby all inorganic ions as well as the dicarboxylic and diamino acids could be separated from methionine. It was expected from theoretical considerations that methionine would behave as a perfectly neutral amino acid and remain in the central compartment of the three compartment ionophoretic assembly, even though Block⁵ has observed that this amino acid is to be found in the anode chamber. Hence ionophoretic separation of methionine from protein hydrolysates was attempted in the following experiments.

Fibrin and casein with an average methionine content of 2.5 and 3.1 per cent. respectively have been employed in these studies. For methionine estimations, the colorimetric method of Sullivan and McCarthy,⁶ as modified by Horn, Jones and Blum,⁷ was found to yield consistent and reproducible values. The amino acid mixture recommended in the method was, however, omitted, but this did not affect intensity of colour or proportionality as measured with the Lumetron photo-electric colorimeter.

100 g. of fibrin (82.15 g. when corrected for moisture and ash), was hydrolyzed with 500 ml. of 25 per cent. (v/v) sulphuric acid for 24 hours. The hydrolysate was neutralised by addition of 177 g. of solid calcium oxide and the precipitate filtered and thoroughly washed. The combined filtrates, which were reduced to a volume of 600 ml. in vacuo. was adjusted to pH 7.5 with sodium hydroxide and placed in the centre compartment of the three compartment cell of Cox, King and Berg.⁸ The two side compartments contained distilled water, the electrodes being then connected to a 220 volt D.C. main and a suitable resistance inserted to give a current of 0.5 amperes. At the end of

24 hours, the anolyte on testing did not indicate the presence of methionine. The ionophoretic transport was allowed to go on for 168 hours, at the end of which period, the centre compartment was practically free from the diamino acids, as indicated by the absence of turbidity with a solution of 5 per cent. phosphotungstic acid in 2N sulphuric acid. The anolyte did not answer the test for methionine even at the end of this period. The liquid in the central compartment was processed for methionine following the directions of Toennis and Kolb,⁴ and 104 mg. of methionine of 96 per cent. purity as determined colorimetrically was isolated. It was further observed that only 60 per cent. of the methionine present in the fibrin originally was accounted for in the analysis of the liquid in the central compartment. As the anolyte did not contain any methionine, it was thought that migration of methionine to the kathode cell might have taken place to a certain extent. This was found to be so in experiments carried out with casein hydrolysate.

250 g. of light white soluble B.D.H. casein (N—15.75% Moisture—10.24% and ash—3.33%) was hydrolysed with 1750 ml. of 20% HCl. for 20 hours. The hydrolysate was freed of humin and the excess HCl was removed by distillation *in vacuo*. The pH was finally adjusted to 7.5 and the hydrolysate was transferred to the centre compartment of the cell. At the end of 24 hours, the liquid in the end compartments was removed and replaced with distilled water; this process was repeated at the end of 48 hours, 120 hours and 264 hours respectively. The centre compartment at the end of the experiment was found to be free of all diamino acids. The anolyte did not answer the test for methionine throughout the duration of the experiment. The methionine contents of the various catholyte fractions and the final methionine content of the liquid remaining in the centre compartment are given in the accompanying Table.

Methionine Content of Various Fractions

Duration of dialysis	Methionine content of anolyte	Methionine content of catholyte	Methionine content of centre comp. liquid
Hours	mg.	mg	mg.
24	nil	391.6	..
48	nil	262.5	..
120	nil	308.8	..
264	nil	490.8	1,746
Total ..	nil	1,363.7	1,746

It is evident from these observations, that under the conditions of ionophoresis employed in these experiments, appreciable amounts of methionine migrate to and are to be found in the catholyte fractions. Since the anolyte fractions both in the case of fibrin and in the case of casein gave a negative test for methionine, there appears to be no migration of this amino acid to the anode contrary to the findings of Block.⁵ It may be that the migration of the methionine is dependent on the sum total of the effects of physical and chemical forces during ionophoresis and the charged nature of the amino acid. However, the establishment of conditions under which all the acidic and basic amino acids will be removed, allowing only the methionine to remain in the centre chamber, would make ionophoretic separation of methionine an excellent technique for methionine preparation, particularly since such a procedure allows the simultaneous preparation of many other amino acids from the same protein. Expensive reagents usually used for effecting such a separation of amino acids are thereby avoided and the ionophoretic method should, therefore, prove useful in the commercial preparation of amino acids from easily available and cheap protein sources of fish meal or slaughter-house blood.

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EFFECT OF AUTOCLAVING ON THE NUTRITIVE VALUE OF BENGAL GRAM, DHAL ARHAR AND LENTIL

THREE pulses—Bengal gram (*Cicer arietinum*), Dhal Arhar (*Cajanus indicus*) and Masur Dhal (*Lentil-lens esculenta*) were compared for their nutritive value. The flour was evenly spread on enamelled trays and autoclaved for 15 minutes at 15 lb. P.S.I. Twenty-four 4-week old, albino rats were evenly distributed into six groups and kept in individual cages. The initial weights of the rats kept on Bengal gram and Dhal Arhar diets were about 36 g. whereas

rats on Masur dhal diets weighed 37 g. Two male and one female rats were used for study with each diet. They were weighed once a week for four weeks and a record of the daily food intake of each rat was also kept. The level of the protein of all the diets was 12 per cent. Table I gives the composition of the diets.

TABLE I
Composition of the diets

	*Bengal gram	*Dhal Arhar
Pulse flour	54	59
Starch	32	27
Salt mixture ⁵	4	4
Hydrogenated fat	9	9
Smoked liver oil	1	1

* Adequate quantity of B-complex vitamins and Choline chloride were added to each diet.

TABLE II
Effect of autoclaving pulses on the growth and food consumption of rats

	Bengal gram		Dhal Arhar	
	Raw	Aut.	Raw	Aut.
Gain in weight per rat per week	5.6	14.7	11.8	8.3
Standard Deviation	0.35	1.73	5.24	2.64
Standard Error	1.05		3.67	
Protein consumed g. per rat per week	4.70	6.14	5.65	4.97
Gain in weight/Protein consumed	1.17	2.40	2.11	1.66

Table II shows that the growth of rats on autoclaved Bengal gram diet was better than that on the raw Bengal gram diet. But the rats fed on raw Dhal Arhar diet gained more weight than those on autoclaved Dhal Arhar diet. The results have been treated statistically and it is found that the difference between the means in the case of Bengal gram diet is significant; whereas in the case of Dhal Arhar, it is insignificant.

In the case of Masur Dhal, however, no difference in growth was observed on the raw and autoclaved diets.

Borchers *et al.*^{1,2,3} have shown the presence of a trypsin inhibitor in *Cicer arietinum*, to the extent of 32.3 inhibitor units whereas *lens esculenta* contained only 6 inhibitor units. They have further shown that about 80 per cent. of the inhibitor was destroyed by

autoclaving the soybean meal at 15 lb. for 15 minutes and that there was no inhibitor present after 20 minutes.⁴ Thus, autoclaving Bengal gram for 15 minutes, has possibly destroyed the trypsin inhibitor and increased its nutritive value.

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VITAMIN B₁₂ IN INFANTILE CIRRHOSIS

THE initial interest in Vitamin B₁₂ as an important anti-anæmic factor has to some extent tended to overshadow other possible physiological effects and clinical applications of this vitamin. The discovery that it is a growth promoting animal protein factor^{1,2} led to its trial in improving the development of children with growth failure.³ Inasmuch as B₁₂ has been shown to play an important role in liver physiology, another possible application is its use in protection against liver injury. This may be of particular interest in India where the condition popularly known as "Infantile Biliary Cirrhosis" (better referred to as Infantile Cirrhosis since pathological studies do not support its biliary distribution) is a very common and highly fatal condition.

Our suspicion that Vitamin B₁₂ might be of value in infantile cirrhosis of the liver was based on the supposition that this condition was nutritional in origin and that this substance, which is both an important liver constituent and an animal protein factor, was probably deficient in the low protein, predominantly vegetarian diets which are common in these areas. Recently evidence has accumulated which helps to elucidate the important role of Vitamin B₁₂ in liver physiology, including its possible usefulness in protecting against liver injury. Close relationships to amino acid metabolism⁴ and to other protective substances such as choline, and methionine^{5,6,7} have been demonstrated. B₁₂ has been found to assist in maintaining the basophilia of the liver cells⁸ and to inhibit the development of certain chemical and histological changes, especially fatty metamorphosis, following carbon tetrachloride intoxication.

tion^{9,10} in rats. Drill and McCormick observed that a B₁₂ concentrate exerted a marked lipotropic effect when injected into rats receiving a high fat diet¹¹ though they were unable to show this effect with crystalline B₁₂.¹² Enlarged livers have been found in B₁₂ deficient animals.^{7,13} Gyorgy and Rose¹⁴ reported that B₁₂ showed significant lipotropic activity in rats fed on a low protein low fat diet though it did not protect against massive hepatic necrosis.

Dinning, *et al.*¹⁵ found that B₁₂ increased the liver choline oxidase activity in rats on diets containing pyridine; and they as well as Gillis and Norris^{16,17} suggested that B₁₂ is concerned in transmethylation mechanisms. Jukes, *et al.*,¹⁸ Stockhead, *et al.*,¹⁹ Ogirsky²⁰ and Stekol *et al.*²¹ obtained evidence indicating that B₁₂ can promote methylation of homocystine or homocysteine to form methionine, which is known to be protective against both massive necrosis and cirrhosis.²² Though homocystine is probably not a normal dietary constituent, these experiments appear to indicate that B₁₂ plays a role in the important transmethylation mechanisms of the liver. However, it was noted^{18,21} that deficient animals grew more rapidly when B₁₂ was supplied in addition to methionine, indicating that its function is not confined to formation of methionine.

To date Vitamin B₁₂ has been used in seven cases of 'infantile cirrhosis' for periods up to five months. In several of these there were family histories of deaths from infantile cirrhosis and of previous attempts at treatment, including use of the popular commercial preparation of unknown composition called "Jammi's Livercure". In all cases the liver was markedly enlarged and two cases had progressed to the stage where the abdominal veins were prominent and engorged. Detailed case reports will be published later, but we feel the results have been sufficiently encouraging to warrant this preliminary note. Usually treatment resulted in prompt improvement in the child's general condition, followed by gradual softening and decrease in size of the liver, though in no instance has the liver yet regressed to the point where it is no longer palpable.

Since several of these cases were treated in rural areas and none was hospitalized, little biochemical or hematological study and no liver biopsies were possible. We realise that evaluation of results on clinical grounds alone is extremely risky. Convincing evidence of the value of B₁₂ in this condition must await further studies under controlled conditions and

must include adequate biochemical and pathological studies. Such studies are in progress but we believe the results thus far obtained justify calling the possibilities of this therapy to the attention of biochemists, physiologists and clinicians who may be interested in this problem. Further work will be necessary to determine whether the apparent improvement noted in these cases will continue, whether treatment with other nutrients in addition to B₁₂ is indicated, and whether the effect of B₁₂ on the liver, if any, is due to a specific influence on liver pathology or merely to a general nutritional improvement in children suffering from a nutritional deficiency.

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BORAX AS A NEW CONDENSING AGENT FOR THE PREPARATION OF CHALKONES

CONDENSING agents like hydrochloric acid, alkalis or phosphorus oxychloride are generally used for the preparation of chalkones from aromatic ketones and aldehydes. It is now found that refluxing the mixture of the ketone

and the aldehyde directly or dissolved in alcohol or acetone with an aqueous solution of borax for three to four hours leads to the formation of chalkones. As with hot alkali, the reaction goes further and flavanones are obtained. To illustrate the procedure employed, the reaction product from acetophenone (5 c.c.), benzaldehyde (4 c.c.) and borax (5 g.) in 25-30 c.c. of water, is steam distilled to remove the unchanged substances and on cooling, the chalkone (1 g.) slowly separates. In the case of resacetophenone and benzaldehyde, 7-hydroxyflavanone that is formed is deposited after keeping overnight.

Thus chalkones have been prepared from acetophenone and *m*-nitroacetophenone, using benzaldehyde, salicylaldehyde and *m*-nitrobenzaldehyde; from acetophenone and *m*-methoxybenzaldehyde and piperonal; from resacetophenone and benzaldehyde and from 2 : 4-dimethoxy-acetophenone and benzaldehyde and *o*-methoxybenzaldehyde.

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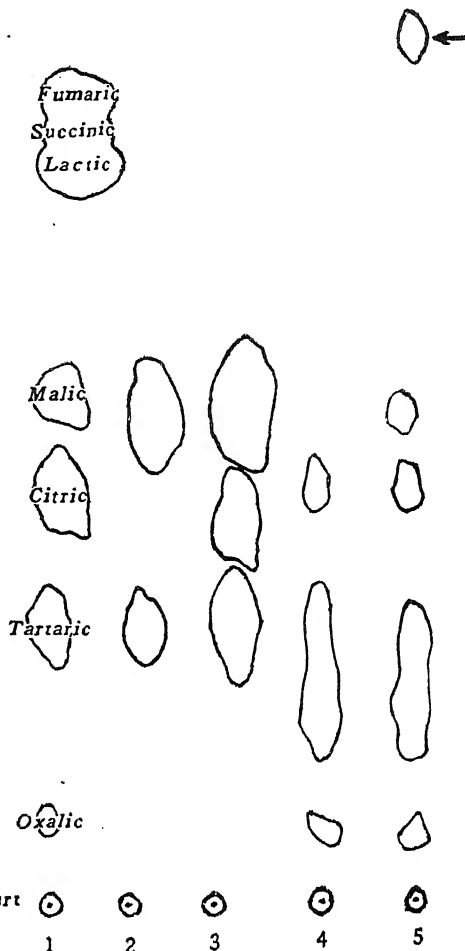
PAPYROGRAPHIC MICROMETHOD FOR THE STUDY OF ORGANIC ACIDS IN PLANTS

STUDIES on the metabolism of organic acids in plants have not rapidly advanced, mainly because of the inherent difficulties encountered in determining small quantities of these metabolites in presence of one another.

Papyrography—partition chromatography on filter-paper—has been used by Lugg and Overell³ while a micromethod for quantities of the order of 10 γ has been developed by Govindarajan and Sreenivasaya² for the separation and identification of nonvolatile fatty acids. In view of the simplicity, elegance and rapidity which characterise the technique and of its applicability to the small quantities (25 to 50 mgm.) of research materials, this method should prove attractive and useful to plant physiologists interested in a study of the organic acid make-up of tissues and tissue fluids.

The technique has been fully described earlier.² By way of illustrating the adaptability of the method we have analysed the acid-alcohol extracts (processed in a Waring

blendor) of the mature leaves of tamarind (*Tamarindus indica* Linn.) and the leaves and stems of *Oxalis corniculata* Linn. The figure (Fig. 1) shows that the mature leaves of



1. Reference Solution—10 γ each of pure organic acids
 2. Tamarind Leaf Extract—0.01 ml.
 3. Tamarind Leaf Extract (0.01 ml.) + Reference Solution (10 γ of each acid).
 4. Leaves of Extract of *Oxalis corniculata*—0.01 ml.
 5. Ext act of Stems of *Oxalis corniculata*—0.01 ml.
- Arrow points to unidentified acid with R_f value 0.9.
- tamarind contains tartaric acid and a larger amount of malic acid (possibly as their salts). Citric acid is absent. The papyrogram developed with a spot of a mixture of the leaf extract and the reference solution of pure acids, confirms the above finding since the tartaric and malic acid spots are bigger in size while the citric acid spot remains nearly the same as compared to the papyrogram of the spot of the

reference solution identical in amounts to that present in the mixture.

The papyrogram of the extracts of leaf and stem of *Oxalis corniculata* Linn., reveals the presence of large amounts of tartaric acid and a comparatively small amount of citric acid. The extract of the stem shows besides, the presence of malic and another acid with an R_f value (Ratio of excursion of spot to excursion of mobile solvent front) of 0.9 which is awaiting identification. In all these extracts the presence of traces of oxalic acid is also suspected because of the presence of the spot near the starting line but this has to be confirmed since the anions added for liberating the organic acids from their salts, also occupy nearly the same positions on the papyrogram.

A singular merit of this method is that the extracts could be directly used for separation and characterisation of the organic acids, since their excursions are generally unaffected by the other constituents, associated with the extract.

The spots of the papyrogram could be excised from another papyrogram developed simultaneously by reference to an indicator sprayed strip, the individual acids extracted separately and determined quantitatively by specific micro-methods.

Our grateful thanks are due to Prof. M. S. Thacker for his kind interest.

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SULPHANILYL BENZAMIDE AND SULPHANILAMIDE: A COMPARATIVE STUDY ON CHRONIC TOXICITY

THE immature mice used as test animals for this study were from the same colony and litter-mates, weighing 10 to 12 gms. each. They were sorted into groups of 6 each so that group weights were mostly equal or differed by less than a gm. only. The drug was mixed with stock diet which consisted of oats, wheat bran, bread and milk. The animals were observed for 15 days under such drug-diet. Group weights were recorded every alternate day for 2 weeks. The experiments were performed simultaneous-

ly to eliminate variation due to environmental conditions.

TABLE I

Drug	Percentage of drug in diet	Group No.	Group wt. initial	Group wt. in gs. on days during drug-diet							Increase
				1	3	5	7	9	11	15	
Sulphanilyl benzamide	0.25	A	68 68	..	78	83	71	79	84	16	
	1.0	B	58 58	68	70	..	77	79	86	28	
	1.0	C	69 69	71	..	77	84	92	98	29	
	2.0	D	62 62	65	..	72	76	80	86	24	
Sulphanilamide	0.25	E	69 69	..	78	80	85	90	96	27	
	1.0	F	58 58	64	69	74	77	80	82	24	
	1.0	G	69 69	73	..	73	77	81	84	15	
	2.0	H	62 62	63	..	64	69	78	85	23	
Control (without drug)	..	I	64 64	74	..	81	..	95	91	27	

From the table it appears that sulphanilyl-benzamide is a well-tolerated drug,^{1,2,3,4,5} having no significant effect on the progress of normal growth rate of immature mice and appears superior to sulphanilamide for all the dosages used. At 2 per cent. drug-diet both exert a small insignificant depression in the growth rate. The unusual depression with the lowest dose of 0.25 mg. per cent. in the case of sulphanilyl-benzamide can only be explained on the basis of random sampling, since, higher dosages used did not confirm such depression.

Bengal Immunity

Research Institute,
Calcutta-16,
December 7, 1950.

A. N. BOSE.

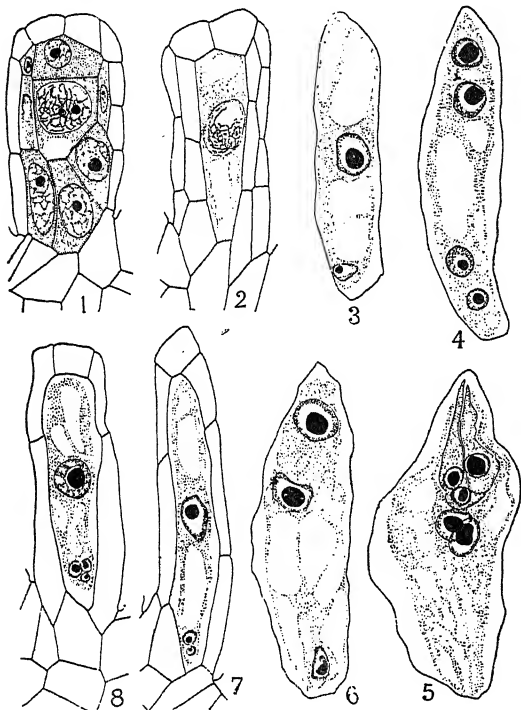
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3. Majumdar, et al., *Ibid.*, 1945, **89**, 500. 4. Bose and Ghosh, *Quart. J. Pharm., Pharmacol.* 1946, **19**, 1.
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THE EMBRYO-SAC OF *FLOERKEA* *PROSERPINACOIDES* WILLD.

OF the two genera of the family Limnanthaceae, *Limnanthes* has been studied by Stenar (1925), Eysel (1937), Fagerlind (1939) and Mason (1949), although without much agreement between any of them. So far there has been no work on *Floerkea* and the present study is based on a collection of *F. proserpinacoides* made by one of us (P.M.) from Wisconsin during 1946.

Wall cells are absent in the nucellus and there is a many-celled archesporium (Fig. 1).

One or two of the hypodermal cells function as megaspore mother cells. The laterally situated cells of the nucellus also enlarge considerably but are ultimately consumed by the enlarging embryosac.



FIGS. 1-8. Development of the embryo-sac; for explanation see text, x 629.

Unlike other plants the megaspore mother cell shows large vacuoles (Fig. 2). The two daughter nuclei formed after Meiosis I are not separated by a wall. The lower of these is always appreciably smaller and moves down to the chalazal end of the cell whereas the upper and larger nucleus lies in the middle of the cell (Fig. 3). Both the nuclei divide and give rise to a four-nucleate stage (Fig. 4). The two micropylar nuclei of the four-nucleate stage divide once and give rise to the egg apparatus and the upper polar nucleus. The two chalazal nuclei have not been observed to divide further. The upper, which is the larger of the two, functions directly as the lower polar nucleus, while the lower degenerates and is usually not recognisable in the mature embryosac (Fig. 5).

While this seems to be the usual mode of development, there are exceptions. Sometimes, after the heterotypic division, the two daughter nuclei may not divide synchronously resulting

in a three-nucleate stage with two nuclei at the micropylar and one at the chalazal end (Fig. 6) or one at the micropylar end and two at the chalazal end (Fig. 7). If the undivided nucleus divides again, the embryosac would again become four-nucleate and follow the same course of development as already outlined above.

One embryosac showed four nuclei of which three were very small and grouped together in the chalazal end of the cell, while the fourth and largest nucleus occupied a more or less central position (Fig. 8). There are two possible interpretations as to the origin of this. Either all the four are megaspore nuclei of which only one is functional; or the micropylar may represent the upper nucleus of the dyad stage and the remaining three nuclei are the products of division of the lower nucleus. It is difficult to say which of these interpretations is the correct one.

Double fertilisation occurs in the usual way and one of the synergids becomes greatly hypertrophied.

The endosperm is free nuclear. There is a considerable aggregation of endosperm nuclei in the vicinity of the embryo and towards the funicular side of the ovule (Fig. 9). Here a haustorial pocket is formed which corrodes the cells of the integument.

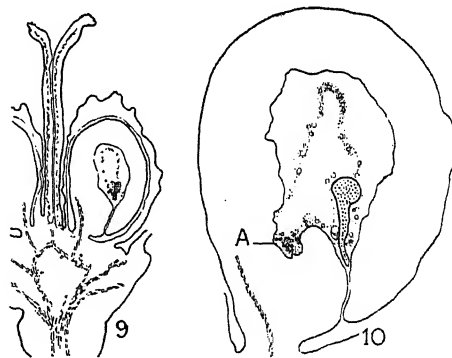


FIG. 9. L. s. carpel, ovule shows free nuclear endosperm, x 24.

FIG. 10. L. s. ovule showing haustorial endosperm-pocket marked 'A', x 48.

Although there are differences in detail, the occurrence of a tetrasporic embryo-sac and free nuclear endosperm is common to both *Flacikea* and *Limnanthes* and confirms the opinion already expressed by several systematists that these two genera should be assigned to a separate family, Limnanthaceae. Further investiga-

tion is, however, needed to clear up the systematic position of this family and it still remains to be seen whether it should be included in the order Sapindales (Engler-Diels, 1936) or the Geraniales (Hutchinson, 1926).

Dept. of Botany,
University of Delhi,
December 22, 1950.

B. M. JOHRI.
P. MAHESHWARI.

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INHERITANCE OF 'CRINKLED LEAF' —A NEW ABNORMAL MUTANT IN ASIATIC COTTON

The crinkled dwarf allelomorph series⁵ in New World group comprising of cr^D and cr^C in *G. barbadense* and cr^I in *G. hirsutum* and the crumpled⁴ and curly leaf³ in Asiatic cottons are instances of abnormal mutants recorded earlier. cr^D and cr^I were simple recessives to respective normal strains while cr^C behaved as a simple heterozygote in crosses with normal *barbadense*. The complementary factors C_p and C_{p_1} were responsible for Asiatic crumpled while the curly leaf cu in Chinese *arborescens* was a monogenic recessive. This note describes a new abnormal leaf mutant in *G. arborescens* differing from these in origin and genetical behaviour.

The mutant was first spotted as a rogue in the seventh generation of an intervarietal hybrid in *G. arborescens*, viz., *indicum* × *cernuum* maintained at Coimbatore. The first leaves were normal and abnormal leaf crinkles developed later from the fifth to seventh leaf presenting the characteristic appearance evidenced in Plate. The leaf abnormality appeared to arise through reduced and disorganized growth of both leaf veins and lamina, thereby throwing the interveinous tissue into folds and crinkles. The leaves remained small and narrow with chlorotic patches, but otherwise the type made good growth under ideal conditions although it was very shy in yield and late in maturity.

The genetics of this abnormal leaf character were studied in crosses with four normal leaved *G. arborescens* types, viz., K.1, CST 3, *cernuum* and '439'. The inheritance was of the blending type with incomplete dominance in F_1 and yielding a ratio of 1:2:1 for nor-



(Crinkled leaf mutant)

mal, F_1 and 'crinkled leaf' phenotypes in F_2 . The normal and 'crinkled leaf' segregates bred true in the F_3 while the intermediates proved to be heterozygous segregating like F_1 . In a back-cross to the normal, the parent and F_1 phenotypes occurred in the ratio of 1:1. The type CST 3 which was also a green stem/ghost² carrying the gene R_2^{as} gave in F_2 an independent segregation for 'crinkled leaf' and 'ghost'. The assortment of meristic character in the normal leaved X-ray induced variant^{1,6} named as '439' was independent of 'crinkled leaf' character in F_2 generation.

The abnormal new mutant character 'crinkled leaf' isolated in *G. arborescens* is assigned the gene symbol cr^a .

R. BALASUBRAHMANYAM.
V. SANTHANAM.

Agricultural Col. & Res. Inst.,
Coimbatore, November 12, 1950.

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XANTHOMONAS CASSIAE, A NEW BACTERIAL DISEASE OF CASSIA

TORA L.

A BACTERIAL leaf-spot of *Cassia tora* growing on the waste lands at Poona, Jalgaon and Baroda was noticed during September, 1948. On leaves, the pathogen produces a few, round, water-soaked spots (1 mm.) surrounded by a distinct halo. Within a fortnight after initial infection, the spots increase in size to 5 mm. with a dark-brown to sooty black centre and a pale brown margin. Outwardly the spots resemble the 'tikka' disease (*Cercospora* leaf-spot) of groundnut. Bacterial ooze in the form of shining beads or fine scales is found on the under-surface of spots. When coalescent, the spots become irregular in shape and rugose as a result of drying of bacterial exudation. Badly affected leaves become yellow and defoliated.

Under favourable conditions of humidity and temperature, side and mid-veins get infected. The infection extends to the petioles and further down to the tender stems, forming vertical streaks sometimes up to 2 in. in length. The initial grey colour of the infected petioles and stems later turns to deep brown or black. Shining gummy beads of bacterial ooze are also found on the infected stems which in advanced stages get slight to deep cracking. Round to irregular, water-soaked spots all over the pods including the edges are common. Constrictions of the pods at one or more places are invariably due to engirdling of the pod by the pathogen.

Xanthomonas cassiae Sp. nov.

Short rod, Gram-negative, capsulated, not acid-fast, motile by a single polar flagellum, stains readily with common dyes and measures $1.2-2.1 \times 0.8-1.0 \mu$. On potato dextrose agar plates, colonies are smooth, circular with lobate margins, shining, convex, butyrous, colour pinard yellow (R), diam. 1.2 cm. after 7 days with striations only at the periphery; on nutrient agar plate, colonies are flat, glistening with fringed margin, colour wax yellow (R), diam. 5 mm. after 4 days; milk peptonised; litmus reduced; gelatin liquefied; casein and starch digested; acid but no gas in dextrose, lactose and sucrose; salicin, arabinose and glycerol not utilised; ammonia and hydrogen sulphide produced; nitrates not reduced: M.R. and V.P. tests negative; sodium chloride tolerant up to 3 per cent.; non-lipolytic; Loeffler's solidified blood serum liquefied in 10 days; slight to fair growth in synthetic asparagin medium; fair growth in

Koser's liquid and solid citrate media; optimum temperature 27° C.; thermal death point 51° C.

The pathogen is carried through the seed of *Cassia tora*.

Plant Path. Lab.,
Coll. of Agric., Poona,
July 30, 1950.

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M. K. PATEL.
G. W. DHANDE.

LIFE-HISTORY OF *MUNTINGIA* *CALABURA* L.

Muntingia calabura L., grown in South Indian gardens, belongs to the family of Elaeocarpaceae. The only embryological work done in this family is that of Mauritzon.*

The archesporium differentiates in four places in the anther primordium. At each place it consists of a plate of 2-3 hypodermal cells. The wall of the anther becomes 5 cells thick. Out of these, the sub-epidermal layer develops into the fibrous endothecium and the innermost layer forms the tapetum which is of the secretory type. The pollen grains are spherical, smooth walled and provided with three germ pores; they are 2-nucleate at the time of shedding.

The ovules are anatropous, bitegmic and show a blunt chalazal outgrowth. The micro-pyle is zig-zag and formed by both the integuments. Megaspores are arranged in a linear tetrad and the chalazal one functions and forms the embryo sac according to the *Normal*-type. The antipodals persist till the time of fertilisation and the polar nuclei fuse just before fertilisation.

Unlike in other Malvales studied, the flowers in *Muntingia* blossom when the ovules are still in the stage of small primordia in which the integument initials have not yet differentiated. Pollination occurs at this stage but fertilisation takes place only after 10-15 days. A similar condition is reported in the Amentiferae and orchids. There is a well marked transmitting tissue in the style and this runs continuous with the glandular epidermis that lines the placenta. The entry of the pollen tube is porogamous. Endosperm is nuclear to start with but becomes cellular later. In the mature seed the nucellus is completely absorbed.

Development of the embryo conforms to the capsella-type. In the seed it is large and straight and its cells, like those of the endosperm, store starch. The cells of the outer epidermis of the inner integument become large and radially elongated and seem to help in

the nutrition of the young embryo. The structure and development of the seed coats are similar to those of other Malvales. A fuller account of the life history will appear elsewhere.

My thanks are due to Prof. A. C. Joshi and Prof. G. N. Rangaswami Ayyangar for their kind encouragement.

Dept. of Botany, C. VENKATA RAO.
Andhra University,
Waltair, November 18, 1950.

* I am thankful to Prof. P. Maheswari for this information.

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ACTIVE RELAXATION OF MAMMALIAN UNSTRIATED MUSCLE^{1,2} DURING INHIBITION PRODUCED BY ADRENALINE

THE uterine horns of a virgin guinea pig are used. Those of a guinea-pig during early pregnancy are also suitable, provided only a small portion of the tube is involved; otherwise, the pregnant uterus does not respond. The animal is killed with a blow on the head and the uterine horns removed and immersed in saline at 25-30° C.; they are then split longitudinally, and, if pregnant, their contents removed.

The muscles are placed in a petri dish containing saline, and adrenaline (1 in 100,000) is added. The composition of the saline was as described previously, being buffered with borate, pH 8.1 (Singh, 1940, 1942). The muscles begin to actively relax immediately. After about 10 minutes they begin to contract. As the tone thereafter increases, active relaxation becomes less or may even disappear if the experiment is repeated every 30 minutes. The muscle may relax up to a maximum of 40 per cent. of its initial length. The elongation is not due to contraction of the circular fibres, as there is no eversion of the split longitudinal edges; besides, substances that cause contraction do not produce any elongation.

Active relaxation may be produced by a concentration of adrenaline as low as 1 in 10 million. The optimum temperature is 25-30° C. At 37° C., active relaxation is feeble and if the tone increases, it is absent. This action of the saline has been described previously (Singh and Singh, 1949). Substances that increase the tone, diminish or abolish active relaxation. These are lithium, ammonium, potassium, excess of calcium, strontium, barium, bromide,

iodide, nitrate, thiocyanate. Asphyxia and cyanide abolish active relaxation; this may be partially restored by glucose. Iodoacetic acid also diminishes active relaxation.

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Physiological Laboratory,
S. N. Medical College,
Agra,
October 9, 1950.

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ON THE OCCURRENCE OF FOLIAR ASCIDIA IN *CLERODENDRON* *INFORTUNATUM* GAERTN.

ABNORMAL ascidia of *Clerodendron infortunatum* Gaertn. (Fam.: Verbenaceae) were first noticed by the writer in 1939 and the variations in the leaf-form a little later.

The ascidium (Fig. 1) occupies the terminal apex of some shoot, being formed by the fusion

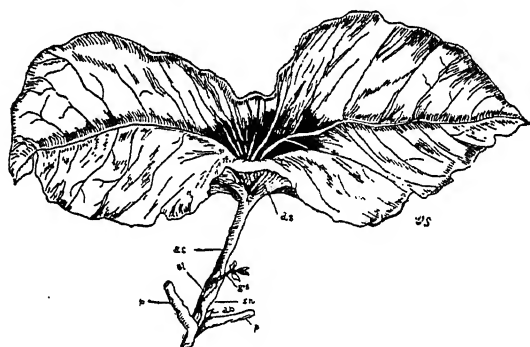


FIG. 1

Terminal ascidium of *Clerodendron infortunatum* (Nat. size). *a*—axillary buds. *s*—stalk of the ascidium. *d*—dorsal side of the blades. *g*—the terminal engulfed bud growing out into a shoot. *p*—basal parts of the opposite petioles below the terminal ascidium. *s*—a natural slit at the base of the ascidium stalk. *v*—swollen node from which the ascidium stalk arises. *v*—ventral side of the blades.

of two leaves opposed to each other. Its fused stalk arises from a node bigger than the normal ones. The terminal young bud is situated at the base, and is engulfed completely by the pouch-like fused stalk of the ascidium. This engulfed bud is very poorly developed. Only in rare cases this bud develops and comes out through a natural slit at the base of the ascidium stalk (Fig. 1, *g. s.*). At first the terminal

socketed bud elongates in a displaced and inclined position but later on, the growing shoot assumes its normal vertical position and the ascidium is displaced to one side.

In the transverse section of the ascidial stalk, it is found that the outer epidermis has uniseriate hairs, the cortex is differentiated into collenchymatous and parenchymatous cells and starch sheath is detected by treating a transverse section with Chlor-Zinc-Iodine solution. Isolated thick cells in small patches of hard bast are found in the pericycle. In the transverse sections of the thicker stalks, however, these isolated patches were almost united to form a ring. Similar formation was recorded by Solereder¹ in the axis of other species of *Clerodendron* and some other genera. Crystals of calcium oxalate are abundant in the ground tissue. The vascular bundles near about the middle part of the ascidial stalk are arranged in two concentric rings which are separated from each other by several layers of broad cells of parenchyma. The vascular bundles of the petiole of the normal leaf are arranged somewhat in a kidney-shaped outline. When two such opposite petioles unite by their margins to form the ascidial stalk, the two sets of vascular bundles are rearranged and are turned into two distinct concentric rings—the outer ring being formed out of the abaxial arcs and the inner ring of the adaxial arcs of the two sets of normal vascular bundles of the opposite petioles. The vascular bundles of the outer ring are collateral, large and are separated from one another by medullary rays of varying breadth. The large vascular bundles of the thick stalk of the ascidium usually increase in diameter by secondary growth as noted by Eames and MacDaniels.² Compared with the vascular bundles of the outer ring, those of the inner are smaller, open collateral and inversely oriented. Slight activity of cork-cambium is found in the older stalks. Within the inner ring of the vascular bundles several layers of cells of the ground tissue are observed. There is a central cavity which is bound by the inner epidermis with cuticle and often a few uniseriate hairs (Fig. 2). Morphological and

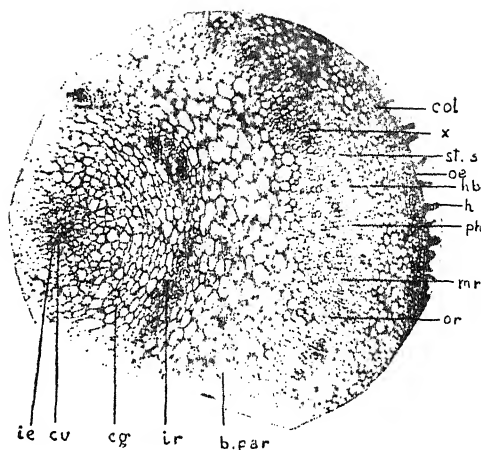


FIG. 2

Photomicrograph of a portion of a trans. sec. of the ascidial stalk of *Clerodendron infundatum* (Eye piece 1 × Obj. S. I. III a). *b.pr.*—broad cells of parenchyma, separating the outer and the inner rings of vascular bundles. *cg.*—cells of the ground tissue between the inner ring of vascular bundles and the inner epidermis bounding the central cavity (*c.v.*). *col.*—collenchymatous cells of the ground tissue. *h.*—epidermal hair. *hb.*—patches of hard bast. *ie.*—inner epidermis bounding the central cavity (*c.v.*) running throughout the ascidial stalk. *ir.*—inner ring of inversely oriented vascular bundles. *mr.*—medullary rays. *oe.*—outer epidermis. *or.*—outer ring of vascular bundles. *pa.*—parenchymatous cells of the ground tissue. *ph.*—phloem. *st.s.*—starch sheath. *x.*—xylem.

anatomical analysis of the cup reveals that the inner and outer sides of the cup correspond respectively to the ventral and dorsal sides of the normal leaf.

Fuller details will be published elsewhere.

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R. G. Kar Medical College,
Calcutta-4,
August 29, 1950.

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CENTRAL BUILDING RESEARCH INSTITUTE

THE foundation-stone of the Central Building Research Institute at Roorkee, Uttar Pradesh, was laid on February 10, 1951 by the Hon'ble Mr. Sri Prakasa, Minister for Natural Resources and Scientific Research. The Insti-

tute will undertake research on building materials, on engineering and structural aspects of buildings and their foundations and on problems of residential comfort, durability of buildings and speed in their construction.

REVIEWS

High-Speed Computing Devices. By the Staff of Engineering Research Associates, Inc. (McGraw Hill), 1950. Pp. xiii + 451. Price \$6.50.

In the words of the authors, "this volume is primarily a discussion of the mechanical devices and electrical circuits which can be incorporated into computing machines". Its contents originally formed a report prepared for the Office of Naval Research, U.S.A., on the state of development of computing machine components. The authors have therefore discussed not only methods which already exist, but also those which appear to be promising, although not sufficiently worked out at present.

The book deals with both digital and analog computers and is divided into three parts: (1) The basic elements of machine computation; (2) Computing systems; and (3) Physical components and methods. General considerations are contained in Chapters 1 and 2. The next two chapters deal with types of electronic counters, switches and gates. Then come three theoretical chapters on the functional approach to design, arithmetic systems and numerical analysis. The binary system has a number of advantages over other systems in the design of computers. Next follow three chapters on digital computing systems such as simple desk calculators, punched-card machines and large-scale electronic computers. Analog computing systems, differential analysers and harmonic analysers, etc., are discussed in a brief chapter. Part III includes a detailed discussion of arithmetic units (*e.g.*, adders and multipliers), components for storage and transfer of data and data-conversion equipment including input, output and radix-changing devices. In the end are given special techniques of possible use in automatic calculation and an outline of some of the factors affecting the choice of components.

On the whole a very comprehensive account, in which the latest information in each subject has been presented by specialists, the book is indispensable for any one who wishes to set up or use automatic computing machines. Particularly valuable is the extensive bibliography included at the end of each chapter. The presentation is highly elegant and the treatment, although quite advanced, is easy to

understand and eminently practical. Scientists and statisticians have to be grateful to the authors for making their report available to a wider circle of readers.

G. N. R.

Crystals and the Polarising Microscope. By N. H. Hartshorne and A. Stuart. Second Edition. (Edward Arnold & Co.), 1950, Pp. xii + 462 and 312 Figs. Price 50 sh.

This second edition is a completely revised and enlarged version of the earlier edition published in 1934. The sub-title, *A Handbook for Chemists and Others*, makes it clear that the book is intended not only for the petrologist and the crystallographer but also for chemists and physicists who are finding more and more uses for the polarising microscope in their studies. To make the latter familiar with the fundamentals of crystallography, the first four chapters deal with topics in morphology, symmetry and crystal structure, stereographic projection and a physical treatment of the propagation of light in crystals. Next follow a description of the polarising microscope and of the methods for preparing and mounting specimens. Two excellent chapters contain the techniques for the examination of crystals in parallel and convergent light respectively. The last four chapters deal with diverse topics such as the use of the universal stage, methods for identifying a crystal from its optical behaviour, liquid crystals and the study of fibres and other biological materials.

The details of the experimental techniques have been given with particular thoroughness, so that it should be possible for a student to learn them without the help of an instructor. The theoretical background is also amply covered, though mathematical details are strictly omitted. The modern Hermann-Mauguin nomenclature is used throughout for point-groups and space-groups. However, a few errors have crept into the description of these symbols. Thus, the authors have wrongly stated that the second m in the description $m\bar{3}m$ of the point-group O_h is a vertical plane of symmetry. Actually, it is a diagonal plane, parallel to (110). In Fig. 54 also, the diagonal planes are omitted. The statement, "Hence the symbol 6_1 means that the operation of such a

six-fold screw axis is equivalent to a translation of the lattice by the length of one cell" is not correct. The associated translation must be $c/6$, not c . A number of similar errors occur in pp. 59-61. These have been pointed out mainly so that they may be rectified in a future edition, but they do not detract from the excellence of the book, which will serve as a suitable text-book for students of mineralogy and a useful reference book for physicists and chemists.

G. N. RAMACHANDRAN.

An Introduction to Electronics. By J. Yarwood.
(Published by Chapman & Hall, London).
1950. Pp. ix + 329. Price 28 sh. nett.

When a large number of books on Electronics already exist, the addition of this work to the number calls for an explanation. This, the author has clearly set out as the need of a book of an intermediate standard between the advanced works and the more elementary ones. Besides, in the opinion of the reviewer, the book lays special emphasis on the physical principles and sets out to give a clear picture of the subject as a physicist looks at it. Such books are not many in the field. Further, the treatment is elementary although quite complete. The exposition is very lucid. As such, the book should be most welcome to all physicists who are not familiar with this branch and to present-day students of physics and engineering as a very good introduction to the subject. The inclusion of chapters on the electron microscope and the U.H.F. tubes is very appropriate and adds considerably to the utility of the book. All types of tubes and the principles underlying their application including the cathode-ray tube and the photo-electric tube come up for treatment. Everywhere, the treatment is well balanced, clear and correct.

The printing and general get-up of the book is very good. The diagrams are well-drawn and reproduced. There is a good bibliography at the end and an index.

The reviewer may add a few suggestions and these should not be misunderstood as criticism. A book of this type goes to a student as an introduction to the vast field of electronics and electronic engineering. As such, it is necessary that there should be at the end of each chapter a few questions and more particularly a number of numerical problems with answers. The real test of a person knowing electronics is his ability to calculate and then rig up a few circuits. Another desirable feature to be

included is to reproduce typical valve data as given by a manufacturer and then set out to calculate a few particulars. This need not be done everywhere, but a few typical cases will be useful. Both these features can be incorporated without adding to the bulk of the book by compressing the first four chapters on electricity and magnetism.

S. V. CHANDRASHEKHAR AIYA.

Radio Aids to Navigation. By R. A. Smith.
Edited by J. A. Ratcliffe. (Published by the Cambridge University Press in the Modern Radio Technique Series), 1950. Pp. xii + 114. Price 9 sh. nett.

This little book is a most welcome addition to the available literature and both the author and the publishers are to be congratulated for producing the book. The amount of literature now available in this field is so vast that the honours student in communication engineering is at a loose end. With the limitations of time and the wide variety of subjects that such a student has to study, it is difficult to expect him to go through journals or special numbers like the *Radio Location Supplement of the I.E.E.* This book presents all the information necessary in a clear manner without going into details.

The book is mainly concerned with aids to air navigation and is divided into fifteen chapters. It deals with short range navigational aids like radar interrogators and responder beacons, D/F, V.H.F. ranges, Gee, etc., after a brief historical introduction, which brings out clearly the problems that presented themselves. This is followed by long range navigational aids like the loran, c.w. systems, etc. Radio altimeters, instrument landing, airfield control, etc., also come up for a balanced treatment. Being mainly descriptive, the book discusses in a very lucid manner each system. Although a British publication, adequate reference is made to developments that took place in Germany and the U.S.A. as in v.h.f. D/F.

The printing and get-up of the book are excellent. The diagrams and plates are well reproduced. The book is indispensable to any communication engineering or physics library.

S. V. CHANDRASHEKHAR AIYA.

Carotenoids. By Paul Karrer and Ernst Jucker, translated by E. A. Braude. (Elsevier Publishing Co., Amsterdam), 1950. Pp. x + 334. Price \$ 8.50.

The carotenoids, constituting a group of yellow to red pigments, are of great interest for

a variety of reasons, among which are their relationship to vitamin A (several carotenoids being precursors of this vitamin), their wide distribution in nature (in plants as well as animals), their chemical character as polyenes and as isoprene derivatives, their light absorption characteristics, and the applications of chromatography to separations in the carotenoid field. When Palmer wrote in 1922 the first book on the carotenoids, little was known of their chemistry. Zechmeister, who has made many contributions to our knowledge of the carotenoids, particularly *cis-trans* isomerism and absorption spectra, reviewed the chemistry of the carotenoids in a book published in 1934. The present book not merely brings the material up to date, but is also a comprehensive treatise which gives a detailed, fully documented and very readable account of the carotenoids. It is well known that much of the recent work on these pigments has been carried out in Karrer's laboratories; the Swiss edition of the book appeared in 1948, and the English edition has the advantage that the translation has been made by a member of the Heilbron school which has been responsible for a long series of important papers on the chemistry of vitamin A and related polyenes.

The book is divided into two parts—general and special. The nine chapters of the general part deal with the occurrence, distribution and formation of the carotenoids in nature, isolation and estimation of the pigments, methods of determining their chemical constitution, *cis-trans* isomerism, and the synthesis of carotenoids. The individual carotenoid pigments are treated in five chapters in the special part. While the literature survey is complete and includes many hundreds of references, the material is presented with remarkable clarity. More attention might perhaps have been paid to recent work on carotenoid metabolism and the physiological activity of pro-vitamins A in relation to their stereochemistry, but otherwise, this monograph will be for many years the indispensable book for study and reference to which workers on any aspect of the carotenoids will turn. A special word of praise is necessary for the very high quality of the printing.

K. V.

Research Bulletin of the East Punjab University. Vol. I, Nos. 1, 2, 3, 4 and 6. Price Rs. 2.

The Bulletin of the East Punjab University recently published, intends to issue at least one

publication on the average per month, the subjects covered being Botany, Zoology, Physics, Chemistry, Astronomy, Mathematics and Geography.

No. 1 of the Bulletin contains a paper by Messrs. Viswath and Gurdev Kaur Gill on the Parallelism between Variations of Taxonomic Value and Cytological Resemblances in Allied Species; Nos. 2 and 3 contain a Table of Values of Liouville's Function $L(t)$ by Hansaraj Gupta; No. 4 by the same author gives a simple proof of the Prime Number Theorem based on Selberg's Formula, while No. 6 describes an Air Control Thermo-Regulator by M. L. Lakhanpal.

Considering the excellent start it has made, it is hoped that the future issues will serve to advance the development of scientific research in this country.

Muscular Contraction—A Topic in Molecular Physiology. By W. F. H. M. Mommaerts. (New York: Interscience Publishers, Inc.; London: Interscience Publishers, Ltd.), 1950. Pp. ix + 191. Price \$4.2.

The advance in this field of science is so rapid, that there is every justification for the appearance of such a booklet. It is very valuable for those who seek an introduction into this field of study and to those who must keep abreast of the present state and the latest developments of the problem. There is mention and discussion of the most recent biochemical investigation on the mechanism of contraction in striated muscle, and description of the actual experimental discoveries and their immediate interpretations. This problem has received wide and many-sided attention for several generations, the work of Meyerhof and Hill being specially significant, and more recently that of Szent-Györgyi.

The book contains fifteen chapters, devoted to qualitative and quantitative aspects of muscle metabolism, sequence of events in muscular activity, muscle proteins, muscle fibres, reaction between ATP and myosin, etc. The scope of the subject-matter is necessarily limited in a book of this size, but there is much stimulating information which should appeal to a very wide circle of readers wishing to know more about developments in these subjects. It is a pleasure to see such a book.

INDERJIT SINGH.

SCIENCE NOTES AND NEWS

Madras University Endowment Lectureships for 1951-52

Applications for Lectureships will be received by the Registrar not later than the 15th March 1951. Applicants are requested to give full particulars regarding their qualifications, etc., and the subject selected by them for the lectures. The lectures are ordinarily to be delivered before the end of January 1952.

Separate applications should be submitted for each lectureship.

The principal terms and conditions of award are given below:

1. *The Maharaja of Travancore Curzon Lectureships*.—Three lectureships of the value of Rs. 250 each, relating to: (a) Medicine—Clinical; (b) Engineering; and (c) Agriculture.

2. *The Dr. Elizabeth Matthai Lectureship*.—Value Rs. 300.—A course of not less than three lectures should be delivered on a subject embodying the results of original investigations in some branch of Medicine and Surgery—preference being given to a subject having special reference to the requirements of women and children.

3. *The Dr. A. Lakshmanaswami Mudaliar Lectureship*.—Value Rs. 500.—A course of not less than three lectures should be delivered at Madras on any subject pertaining to Medicine in any of the various departments including Medical Education, Medical Relief and Public Health and History of Medicine.

Ramanujam Memorial Prize, 1951

"The Ramanujam Memorial Prize" of the value of Rs. 500 will be awarded for the best essay or thesis written on any branch of Mathematics, embodying the result of the personal investigations of the author and containing clear evidence of independent and original research. The prize is open to all persons born or domiciled in India. Intending competitors should forward their essays or theses so as to reach the Registrar, University of Madras, not later than the 1st December 1951. Further details can be had from the Registrar.

International Seminar

An international seminar is being organised by the World Federation of United Nations Associations in connection with the Seventh Session of the Economic Commission for Asia and the Far East (ECAFE). The seminar will

be held at Lahore (Pakistan) from February 27 to March 7, 1951, concurrently with the Commission's Session.

The object of the seminar is to make more widely known the work of the United Nations and especially of the ECAFE. The lectures at the seminar will be so arranged that those attending the seminar will also be able to attend the meetings of the Commission.

European Physics Laboratory

Offers have come from Italy and France of financial help to permit UNESCO to study the possibility of setting up a West European Physics Laboratory for High Energy Particles. The study is to be made under the direction of Prof. Pierre Auger. It is proposed that the laboratory should house a cyclotron for producing particles of enormous energy.

Sir Alexander Fleming

Sir Alexander Fleming, the well-known British scientist who discovered Penicillin, has been elected an Honorary Fellow of the National Institute of Sciences in India.

Origin and Distribution of Cultivated Plants in South Asia

The Indian Society of Genetics and Plant Breeding in collaboration with the UNESCO Office, Delhi, organised a Symposium on the above subject in Delhi from January 12 to 15. Besides participants from the countries of South Asia, Prof. Edgar Anderson (U.S.A.), S. C. Harland (U.K.) and A. Muntzing (Sweden) participated and there was a delegation of four Chinese botanists from the Academia Sinica. The complete proceedings will be published by the sponsoring Society and orders may be placed with the Secretary of the Society, C/o Division of Botany, Indian Agricultural Research Institute, New Delhi 5. A few sets of the abstracts of the papers contributed to the Symposium together with a short account of the discussions may be had from the UNESCO Office for instructions.

Facilities for Study Abroad

In order to help all those in need of information, a book entitled *Study Abroad* collecting all information about financial assistance for study and training in all foreign lands was published by UNESCO first in 1948, which is

now in its third edition listing in all 35,000 offers. This book is on sale at 6 shillings from UNESCO's official sales agents (for India, Oxford Book and Stationery Co., Scindia House, Connaught Circus, New Delhi). Any bookseller in any other country may also procure it from the nearest sales agents for publication of UNESCO.

Dr. Bharucha

Dr. F. R. Bharucha, Professor of Botany, Institute of Science, Bombay, who attended the Seventh International Botanical Congress held last July in Stockholm as a delegate of the Governments of India and Bombay, has been appointed a Delegate for India on the following International Commissions:

(a) International Commission for Applied Ecology.

(b) International Commission for Phytosociological Nomenclature.

(c) International Sub-Commission for Grassland Ecology.

These three Commissions and Sub-Commissions are under the auspices of the International Union of Biological Sciences of the UNESCO.

(d) International Sub-Commission on the Vegetation Cartography on the scale 1:1,000,000.

As a Delegate for India, Dr. Bharucha will co-ordinate the work on Grassland Ecology in India and promote work on Phytosociological basis, and call for an All-India Conference on Grassland Ecology and on Vegetation Cartography shortly.

Indian Phytopathological Society

At the Annual General Meeting of the Indian Phytopathological Society held on 3rd January, 1951, at Bangalore, the following office-bearers were elected to the Council for the current year:—

President: Dr. M. K. Patel. **Vice-President:** Dr. R. P. Asthana. **Secretary-Treasurer:** Dr. R. Prasada (1950-52). **Councillors:** North Zone—Dr. M. K. Hingorani; Mid-East Zone—Dr. P. R. Mehta; Eastern Zone—Prof. S. R. Bose; Central Zone—Dr. S. Vaheeduddin; Western Zone—Dr. M. N. Kamat; Southern Zone—Sri. T. S. Ramakrishnan.

Zoological Society of India

The following were elected as Office-bearers of the Zoological Society of India, at the Annual General Body Meeting of the Society held at Bangalore in January this year:

President: Dr. K. N. Bhal, Professor of Zoology, Lucknow University, Lucknow; **Vice-Presidents:** Dr. S. L. Hora, Director, Zoological Survey of India, Calcutta; Dr. M. A. Moghe, Principal, Amraoti College, Amraoti; **Secretary:** Dr. M. L. Roonwal, Forest Entomologist, Forest Research Institute, Dehra Dun; **Treasurer:** Dr. B. S. Chauhan, Zoological Survey of India, Calcutta; **Editor:** Dr. B. N. Chopra, Fisheries Development Adviser, Govt. of India, New Delhi; **Members:** Dr. H. S. Pruthi, Plant Protection Adviser to Govt. of India, Ministry of Agriculture, New Delhi; Dr. N. K. Panikkar, Chief Research Officer, Central Marine Fisheries Research Station, Mandapam; Dr. A. B. Misra, Professor of Zoology, Banaras Hindu University, Banaras; Dr. H. R. Mehra, Professor of Zoology, Allahabad University, Allahabad; Prof. R. V. Seshaiya, Professor of Zoology, Annamalai University, Annamalaiagar; Dr. Bhaskaran Nair, Professor of Zoology, University College, Trivandrum.

ERRATA

Vol. 20, No. 1, page 14, column 1: Note on "Compressibility and Complex Formation in Electrolytes".

Line 7: read $\bar{F}_2 - \bar{F}_0$ instead of $\bar{F}_2 = \bar{F}_0$

Line 11: The expression should read

as follows: $\bar{K}_2 - \bar{K}_0 = f(D, P, V) (\sum \nu_i z_i^2)^{3/2} C^{1/3}$

Line 16: The sentence beginning with "The consequent decrease . . . is predominant" should read as follows: "The consequent decrease in valence factor $(\sum \nu_i z_i^2)^{3/2}$, and ionic density are seen to involve a decrease in \bar{K}_2 actually observed, etc., . . . is predominant".

The references to the Note are as follows:

1. Nayar and Pande, *Proc. Ind. Acad. Sci.*, 1948, **27A**, 285; 349.
2. Narasimhanurthy, *Ibid.*, 1950, **31A**, 160.
3. Bachem, *Zeits. f. Phys.*, 1936, **101**, 541.
4. Gucker, *Chem. Rev.*, 1933, **13**, 111.
5. Glasstone and Saunders, *J. Chem. Soc.*, 1923, **123**, 2134.

Vol. 20, No. 1, page 14, column 2, line 30: Note on "Polarisation of Brillouin Components in Light-Scattering in Liquids".

The sentences beginning with "The scattering . . . recent note" should read as follows: "The scattering due to 't_n' waves is stronger of the two, and evidence for the existence of such waves has been given by me in a recent note."

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THE LUMINESCENCE OF DIAMOND—IV

SIR C. V. RAMAN

1. STRUCTURE AND CRYSTAL SYMMETRY OF DIAMOND

THE clue to an understanding of the luminescence of diamond is to be sought for in the relationship between the spectroscopic properties of the material on the one hand and its crystal structure on the other. Of fundamental importance in this respect is a result which emerged from the Bangalore investigations, namely, that the diamonds which are the most perfect as indicated by their freedom from birefringence and by the low intensity and extreme sharpness of their X-ray reflections are those which most prominently exhibit the infra-red absorption of the first-order between 7μ and 14μ , and the series of sharply-defined absorption lines in the ultra-violet spectrum between $\lambda 2250$ and $\lambda 3500$. *Per contra*, the diamonds which do not manifest either the infra-red or the ultra-violet absorption in these regions are

those which exhibit the maximum of imperfections in their crystal structure, as indicated by the birefringence which they display and the intense and diffuse X-ray reflections which they give. These facts preclude us from ascribing the activity in infra-red and ultra-violet absorption present in one case and absent in the other to irregularities in crystal structure, and compel us to recognise that there is, in fact, a fundamental difference in structure between the two varieties of diamond. Spectroscopic theory enables us to specify the nature of such difference. If the electronic structure of diamond possesses centres of symmetry located, at the points midway between every pair of neighbouring carbon atoms in the crystal lattice, the diamond would necessarily be infra-red inactive in the first-order vibration spectrum. But, if on

the other hand, such centres of symmetry are absent, the diamond would necessarily exhibit an infra-red activity of the first-order. Such a fundamental difference in electronic structure may be expected also to manifest itself in a notable difference in respect of ultra-violet absorption, as is indeed actually observed.

I

II

III

vity of crystals having a heteropolar constitution. It is also necessary to point out that the lower symmetry of the infra-red active diamond, whatever may be its origin, would not necessarily involve either piezo-electric or pyro-electric activity. The feebleness of the infra-red activity is itself also an indication

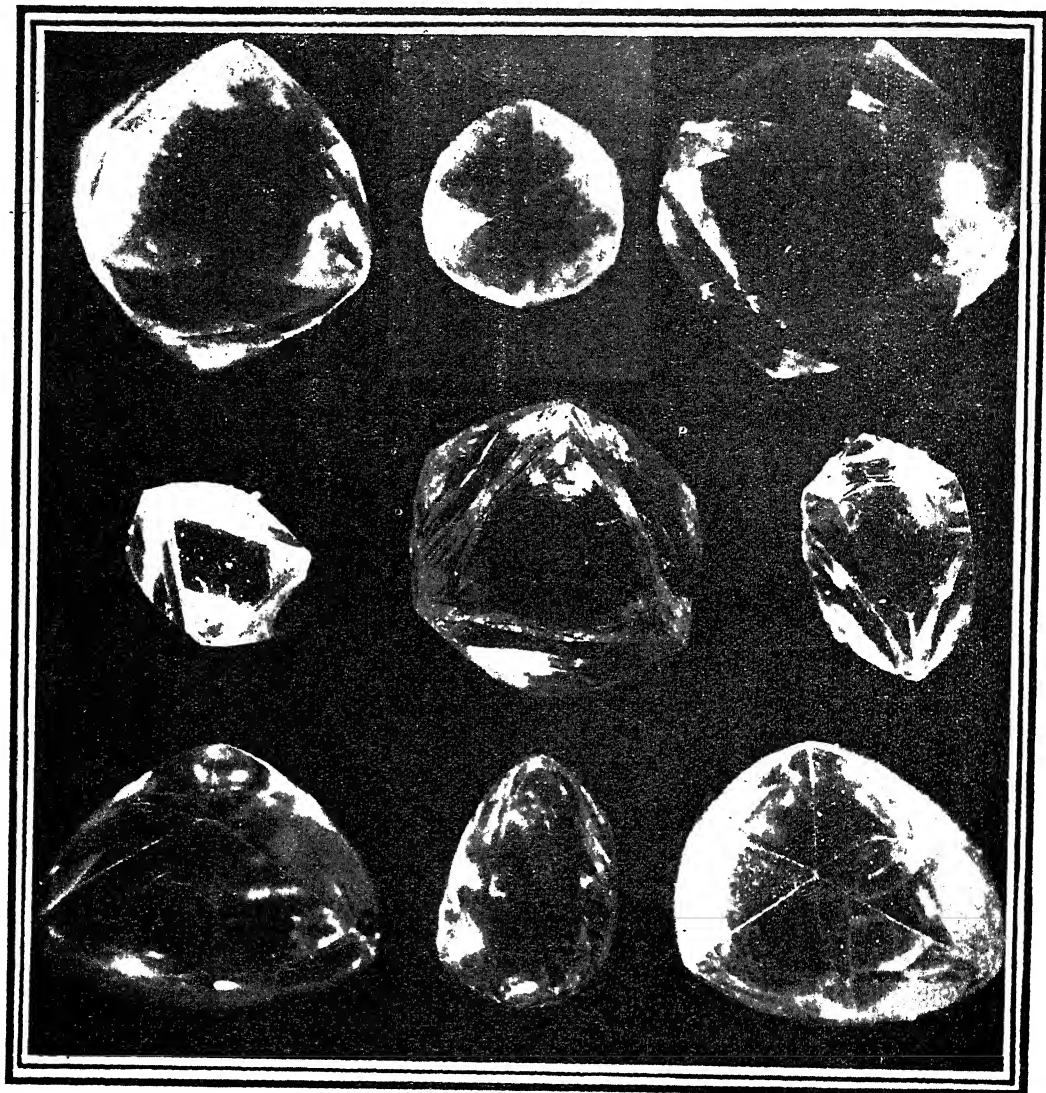


FIG. 1. Photographs of Diamond Crystals

Thus, spectroscopic theory leads us to recognise the existence of two varieties in the crystal structure of diamond possessing respectively tetrahedral and octahedral symmetry. It may be remarked that the infra-red activity present in one case and absent in the other is very feeble compared with the infra-red acti-

that the differences in structure between the tetrahedral and octahedral varieties when expressed in quantitative measure are very small. It is, therefore, not surprising that the two varieties of diamond make a very close approach to each other in many of their physical properties.

important consequence. Since both structures belong to the cubic system, we should expect that their appearance side by side in the same specimen of diamond should be a very frequent occurrence. That this is indeed actually the case is shown by the frequency with which patterns of ultra-violet transparency are observed in cleavage plates of diamond, as already mentioned in an earlier article of the series. These patterns always exhibit a geometric character, the boundaries of separation between the opaque and transparent regions running parallel to the octahedral or dodecahedral planes in the crystal lattice. This is ocular evidence that we are concerned with a real difference in structure between the areas under consideration.

2. THE CRYSTAL FORMS OF DIAMOND

It is well known that crystals of the tetrahedral class in the cubic system frequently exhibit interpenetration twinning, as the result of which their external forms imitate or mimic octahedral symmetry. It follows that such interpenetration of the positive and negative tetrahedral forms should be commonly observable in crystals of diamond. This is fully borne out by experience. Indeed, from the very beginnings of crystallographic science, it had been noticed by mineralogists that the evidence presented by the crystal forms of diamond very definitely placed this substance in the tetrahedral class and indicated a strong disposition on its part to imitate octahedral symmetry by interpenetration twinning.

Fig. 1 reproduces photographs of nine crystals from the Bangalore collection which illustrate the tendency of diamond to exhibit pseudo-octahedral forms as the result of internal twinning. Five of the diamonds, *viz.*, A I, A II, C I, C II and C III are from Panna in Central India and have the rounded forms with smooth lustrous faces characteristic of the finest diamonds from that locality. They also show a feature which is highly characteristic of diamonds with curved surfaces, namely a pattern of sharp ridges which run along the six reflection planes of tetrahedral symmetry and divide the external area into 24 triangular areas (see for instance, A II, which is a nearly spherical diamond). A I, which is octahedral in its general shape, exhibits six sharp vertices where four ridges meet, while at each of its eight face-centres, six ridges meet: but the edges characteristic of a real octahedron are missing, being replaced by smoothly curved surfaces. On the other hand, the diamonds pictured in C I, C II and C III, have forms in which the features

characteristic of a hexakis-tetrahedron may be readily recognised, C I being the best example in this respect in the collection. The three diamonds reproduced as B I, B II, B III illustrate another typical form of diamond, *viz.*, octahedra with plane faces and grooved edges. B II (the central picture in Fig. 1) is a particularly fine example of this class from South Africa. It exhibits sharply-defined re-entrant edges which limit the faces of the octahedron and give them a hexagonal instead of a triangular outline. The form is very clearly a consequence of the interpenetration twinning of positive and negative hexakis-tetrahedra.

3. THE ORIGIN OF THE BLUE LUMINESCENCE

The existence of interpenetration twinning in the tetrahedral type of diamond which is demonstrated by the study of its crystal forms allows us to offer an intelligible explanation of the observed association of blue luminescence with this particular variety of diamond. Every boundary within the crystal at which the positive and negative tetrahedral structures meet is a discontinuity in the crystal structure. The finer the subdivision of the entire volume of the crystal between the two interpenetrating structures, the more numerous would be the possible centres of luminescence brought into existence thereby. The interpenetration of the positive and negative tetrahedral forms thus furnishes a mechanism for the production of luminescence centres in greater or less number and, therefore also for a highly variable intensity of emission as between different specimens or within the volume of any given diamond, as is actually observed.

If the blue luminescence arises in the manner stated above, it follows that an increased intensity of luminescence would necessarily mean an increase in the lack of perfect homogeneity in the lattice structure of the crystal. In other words, the more intense the luminescence which a diamond displays, the less perfect would it be as a crystal. This consequence was actually foreseen by the present writer before X-ray studies confirmed its reality. In particular, an investigation by Dr. G. N. Ramachandran established the existence of a quantitative relationship between fluorescence intensity and the characters of the X-ray reflections by the lattice planes of the crystal, *viz.*, their intensity and their angular range.

A further consequence of the idea that interpenetration of the positive and negative tetrahedral forms is the origin of the blue luminescence may also be pointed out. If the subdivision of the crystal by such interpenetration

tration is carried far enough, we should expect the behaviour of the diamond to be noticeably altered as the result of the juxtaposition of the oppositely directed tetrahedral structures at their boundaries of separation. In particular, a diamond which exhibits an intense blue luminescence may be expected to differ noticeably in its behaviour in respect of infra-red and ultra-violet absorption from a diamond which shows only a weak luminescence. This, again, has actually been observed. One finds a distinct weakening of the infra-red activity characteristic of the tetrahedral type of structure in the more strongly blue-luminescent diamonds; simultaneously, the sharp absorption lines in the ultra-violet between $\lambda 2250$ and $\lambda 3500$ tend to become weaker and the diamond as a whole becomes more transparent to that region of the spectrum.

octahedral or dodecahedral planes in the crystal. The use of a Babinet compensator in addition reveals that the lamellæ present in the diamond are alternately under tension and compression. It thereby becomes evident that the birefringence arises from the co-existence in the same specimen of two sub-species both having octahedral structures but of slightly different lattice spacings (see Fig. 2).

As already remarked, intergrowths of the octahedral and tetrahedral species of diamond are exceedingly common. Cleavage plates in which there are such intergrowths invariably exhibit birefringence. They also exhibit bands of green luminescence. It is evident that when diamond of the non-luminescent or octahedral type and of the blue-luminescent or tetrahedral type are present side by side in the same specimen, the boundaries between them would re-

I

II

III

IV

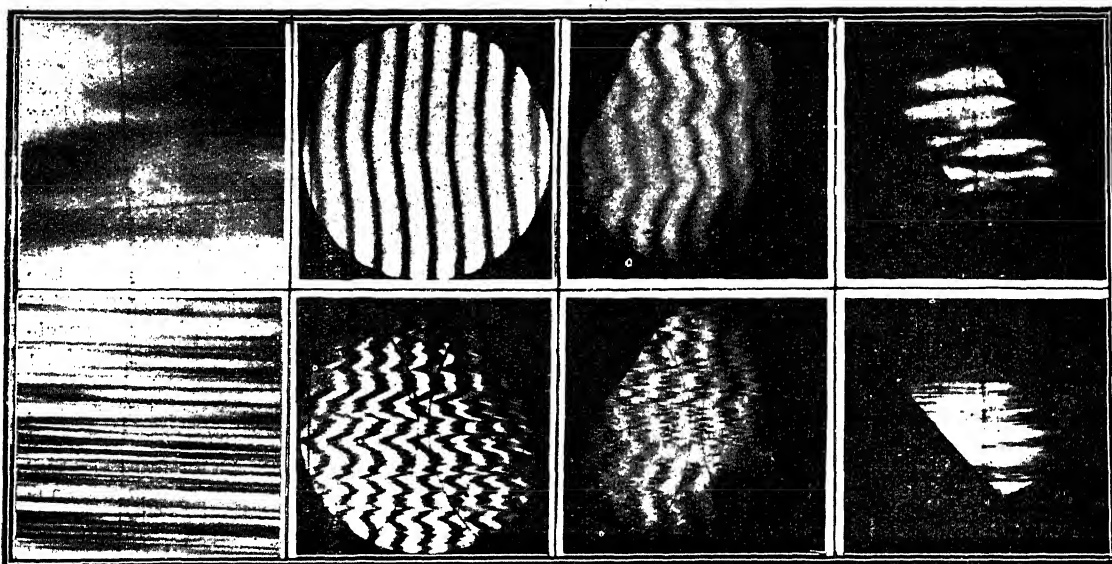


FIG. 2. Birefringence of Diamond as seen in the polarising microscope on the Federov stage: A as viewed normally, and B as viewed under tilt: I and IV without compensator, and II and III with it.

4. THE ORIGIN OF THE GREEN LUMINESCENCE

One need not be surprised that the diamonds having an octahedral symmetry of structure are not luminescent under ultra-violet irradiation. For, they are transparent to radiations of wave-length greater than $\lambda 2250$, and if there is no absorption, there can be no re-emission. The origin of the birefringence exhibited by such diamonds becomes clear when a cleavage plate of the same is examined under a polarising microscope provided with a Federov stage. It is then found that the birefringence is due to a lamellar structure running parallel to the

present discontinuities of crystal structure. Since absorption of ultra-violet radiation can occur in the vicinity of such boundaries, there is clearly a possibility of their functioning as centres of luminescence. There is ample experimental evidence to show that the green type of luminescence arises in this way. In the first place, one can understand on this basis why both the blue and green types of luminescence usually appear together, though in varying ratios of intensity. One can also understand why the green luminescence exhibits a banded structure and why there is a perfect

correspondence between such structure and the birefringence pattern observed in the same diamonds. Then again, it is found that when a cleavage plate of diamond showing the banded green luminescence is tilted one way or another, the birefringence and luminescence bands both sharpen in one position and both become diffuse in the other position, showing that they have a common orientation in the crystal. See Fig. 3 in which A and B represent the same cleavage plate photographed in two different directions relative to its surface. I represents the green luminescence bands and II the birefringence.

thus affording support to the hypothesis that both the green luminescence and birefringence arise from local variations in crystal structure. We may further remark that the explanation given above for the origin of green luminescence is supported by the observation that the patterns of ultra-violet transparency exhibit a close correspondence with such luminescence. The X-ray topographs also show a great intensity of X-ray reflection along the bands of green luminescence.

5. CONCLUDING REMARKS

The foregoing account of the subject has been confined to statements of fact and to inter-

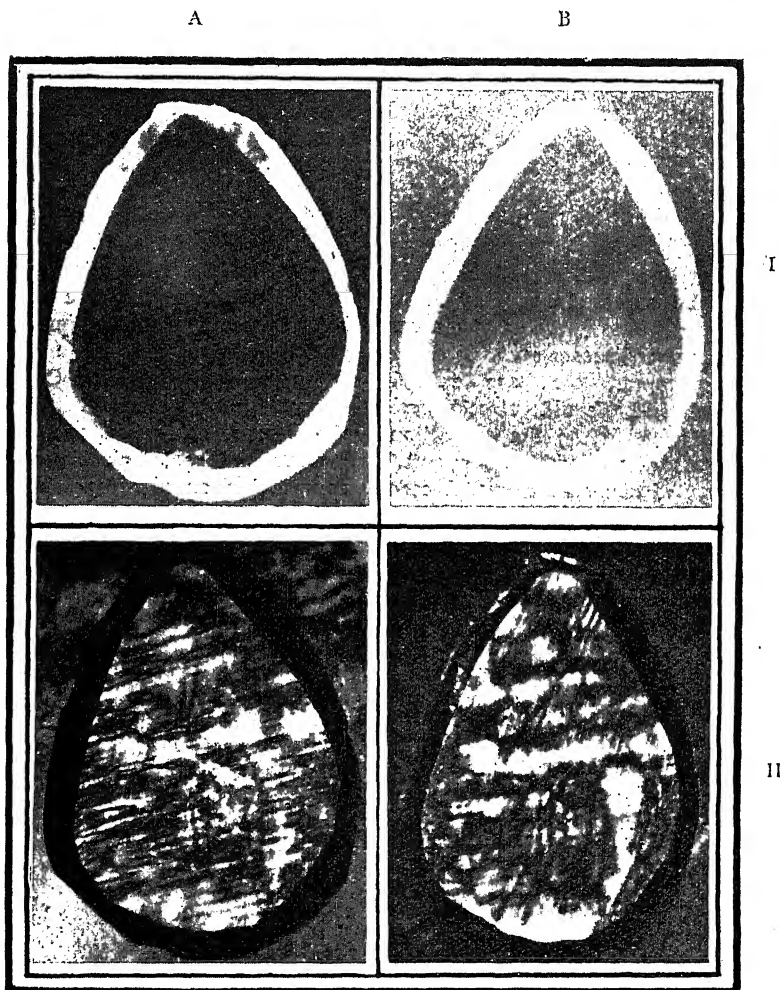


FIG. 3. Showing Effect of Tilting on Birefringence and Luminescence

From measurements of the tilt of the plate necessary to give the maximum sharpness to the bands, it is readily shown that we are concerned with layers running parallel to the octahedral or dodecahedral planes in the crystal,

pretations of the same based on well-established principles and therefore of a compelling nature. There are other aspects of the subject which are of interest but being of a somewhat speculative character have not been touched upon

here. For instance, what is the exact nature of the difference in the electronic structures exhibiting respectively tetrahedral and octahedral symmetry? Why are there two subspecies of octahedral symmetry, as is evident from the lamellar structure and birefringence of non-luminescent diamond? We have also not dealt with various other important issues which arise from the facts under consideration. What

is the scheme of electronic energy levels in diamond which give rise to the observed emission and absorption spectra? Why are the transitions between them allowed in some cases and forbidden in others? Unless we are in a position to answer such questions, we cannot claim to have fully understood either the structure of diamond or the many fascinating phenomena which it displays.

HUMAN BIOLOGY AND SOCIAL WELFARE

IN his Presidential Address to the Section of Anthropology and Archæology at the 38th Session of the Indian Science Congress, Bangalore, 1951, Dr. Sarkar makes out a case for the role of human biology in the process of building up the welfare state. He lays emphasis on the numerous gaps in our knowledge of the fundamental problems of the science due to long neglect. In many parts of India there is no compulsory registration of births, marriages and deaths. The work of the geneticist and the social and civic legislator is thus made difficult by the absence of adequate information and scientific knowledge which could be collected easily by scientific bodies and hospitals. Case reports and clinical data of common diseases such as tuberculosis, venereal diseases, etc., are entirely lacking. A central body could classify and publish such data if collected by the institutions concerned. A system of universal finger printing would settle out of court all disputed cases of identity and prevent frauds and forgeries. Population problems have been tackled so far by alarmist economists and not by sound biologists. Dr. Sarkar is of the view that there is no fear of over-population. The ban on widow marriage in Bengal is depleting the population of the food growers of the country.

Though the work done so far on the menarcheal age of women in India is not conclusive, there are indications to show that the menarcheal age is going down especially in those communities whose socio-economic con-

ditions are better. The Age of Consent Committee's findings in this respect are not satisfactory.

Dr. Sarkar regrets that in no case of disputed paternity have the law courts called in at any time for expert scientific opinion. Drawing up a parallel between the varied aspects of family life in India and the United States, Dr. Sarkar finds that there are many common characteristics of the modern family in both the countries such as urbanization, secularization and a trend to companionship. The only feature in which America differs from India is in the high divorce rate in America with its basic instability of the family, a feature which will become characteristic of India as well on the passing of the Hindu Code Bill. Dr. Sarkar deprecates such legislation as divorce laws in the absence of factual and statistical studies of genetic and sociological problems. A national commission on marriage, he says, should precede the Hindu Code Bill.

Even the much maligned caste system with its group endogamy and clan exogamy has been productive of beneficial results in India, says Dr. Sarkar. Of the sixteen Bengalis who were Presidents of the Indian National Congress, nine have been Kayasthas who are cited as an example of the Galton-Pearson ideal of national eugenics—a dominant fertility of the fitter stocks. Social legislation, says Dr. Sarkar, should be broad-based on this biological axiom.

C. J. JAYADEV.

ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS

IN view of the ever-increasing use of physical methods in problems of biochemistry—especially in borderline fields, Academic Press announces the intended widening of the scope of its journal, *Archives of Biochemistry*. In addition to established biochemical topics, the Editors will consider manuscripts in the fields of virus research, radiation effects on living matter, macromolecular biology and chemistry,

studies of the application of radioactive indicators, and physics of biological systems.

Beginning with Volume XXXI, Number 1, March 1951, the title of *Archives of Biochemistry* will be changed to *Archives of Biochemistry and Biophysics* to indicate more accurately the new scope of the journal. The Editorial Board has also been enlarged; Drs. E. Newton Harvey, E. C. Pollard, and R. W. G. Wyckoff have accepted an invitation to serve,

PAPYROGRAPHIC STUDIES ON THE DEGRADATION PRODUCTS OF NUCLEIC ACIDS

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NUCLEIC acid metabolism has engaged our close attention since 1948 because of its intimate association with (a) protein synthesis in yeasts; (b) glandular secretions in the guinea pig; and (c) viral proliferations in the guinea pig, subjects in which this laboratory has been interested for some time. We have found periodic fluctuations in the basophilic content of the contents of the yeast cell, which is parallel to the mitotic phases.^{1a,b} Basophilicity has been found to be related to nucleic acid content of the cell; similar fluctuations have recently been made by us² in respect to the progressive increase in nucleic acid content of the silk gland as it develops to maturity.³ In viral proliferation the first reaction of the host to virus infection results in an increase in the perinuclear area together with a striking increase in electron density. The virus thus induces a ribonucleic acid synthesis in the infected cells immediately followed by growth and protein synthesis.

in these laboratories. Papyrographic separations possess the further advantage of securing for quantitation constituents of spectro-photometric standards of integrity and purity, which enable us to identify and estimate them with considerable ease, accuracy and elegance.

The application of paper chromatography (papyrography) to problems of nucleic acid chemistry was first reported by Vischer and Chargaff,⁵ who extended this technique to a quantitative analysis of purines and pyrimidines of nucleic acids. The procedure consists in locating the constituents of one-dimensional papyrograms (50 × 2 cm.), developed with solvent mixtures (see Table I), by treating the papyrograms with mercury salts on guide strips and converting this salt to the black sulphide of mercury. These black spots serve as a guide for elution of purines and pyrimidines from the corresponding areas of the untreated papyrogram. The papyrographic procedure described by Hotchkiss for the location and quantitation

TABLE I

Solvent systems	Constituents separated	Author and Reference
Inoline collidine	.. Adenine and Guanine	Vischer and Chargaff ⁵
.. (neutral)	.. Adenine, Guanine	
.. collidine morpholine	.. Hypoxanthine, Xanthine	
.. plus diethylene glycol	.. Uracil, Cytosine, Thymine, and corresponding nucleosides	
.. diethylene glycol		
.. plus HCl	.. (Nucleotides do not move in any of these solvents)	Vischer, <i>et al.</i> ¹⁰
.. —HCl		
.. lactic acid—Amm.	.. Adenylic acid cytidylic acid and Uridylic acid plus Guanylic acid	Vischer, <i>et al.</i> ¹¹
.. urate pH 3.6	.. Cytosine, Uracil, Adenine, Thymine, Cytidine, Guanosine and Thymidine	Hotchkiss ⁶
.. collidine—NH ₃	.. Adenine, Guanine, Uracil, Cytosine, Thymine and corresponding nucleosides	Carter ⁷
.. —10% Urea	.. Separates nucleotides	do
.. citrate pH 3.6 Iso amyl alcohol	..	
.. pH 9.6	..	
.. Dihydrogen phosphate—Iso amyl alcohol	..	
.. Hydrogen Phosphate—Iso amyl alcohol	..	
.. Dihydrogen Phosphate—Iso amyl alcohol	..	
.. anol—HCl—H ₂ O	.. Adenine and guanine and pyrimidine nucleotides	Markham and Smith ⁸

In search for micro-analytical methods for determination of the nucleic acid constituents we have explored the possibility of using the papyrographic method^{3,4} pursued

of the constituent,⁶ entails the elution of purines, pyrimidines and nucleosides from successive areas of the papyrogram developed with butanol and a determination of the ultra-

violet absorption of the eluates from these areas. Carter⁷ has evolved a technique for resolving mixtures of purines, pyrimidines, nucleosides and nucleotides of yeast nucleic acid with solvents indicated in Table I. A special feature of his papyrographic technique, involves the employment of a two-layered solvent system where the filter-paper is introduced so as to pass through both the phases. He locates these compounds on the papyrograms by ultra-violet fluorescence, thus eliminating the necessity of having guide strips. Markham and Smith⁸ have developed a photographic technique based on the characteristic absorption of these compounds in the ultra-violet (253.7 and 265 $m\mu$).

A careful study of Table I reveal that among the immiscible alcohols, butyl and *iso*-amyl have been used. Miscible alcohols have not so far, been used as developing solvents for papyrographic separations. *N*-propanol—0.5 *N* HCl has, however, been used for the separation of the constituents on a starch column. In our present study, an attempt has been made to compare the relative merits of several solvent mixtures.

EXPERIMENTAL

Inverted bell jars (14 cm. \times 26 cm.) with ground edges securely covered with ground glass discs with vaseline, were used as developing vessels. The solvent mixture (30 ml.) was placed at the bottom in a separate (8 cm.) petri-dish. Filter-paper (Whatman No. 1) (10 cm. \times 20 cm.) carried 5 spots. Four of them consist of 0.01 ml. of a 1% solution of adenine sulphate (GBI), guanine (BDH), uracil (GBI) and xanthine (GBI), prepared according to the methods given by Gyorgi.¹¹ The fifth spot represented a mixture of the above constituents.

The solvent systems employed are: (1) 2:1 ethanol 0.5 *N* HCl; (2) ethanol in ammonia atmosphere; (3) 2:1 propanol—0.5 *N* HCl; (4) propanol in ammonia atmosphere; (5) butanol—5 per cent. aqueous urea; (6) butanol in ammonia atmosphere; (7) *iso*-amyl alcohol—ammonium citrate (two-layer system); (8) *Isobutyric acid*-ammonium isobutyrate at pH 3.6-3.7. The spotted filter-paper placed in the vessel attained equilibrium with the vapour-phase of the solvent mixture; filter-papers were then lowered into the petri-dish containing the developing solvent. The time taken for developing the papyrogram usually takes about 4 hours, at the room temperature (24 to 25°C.). The filter-paper was then air dried and printed photographically over Ilford document paper No. 50, employing the ultra-violet radiation as

recommended by Markham, *et al.*, with slight modifications. The position of the constituents were located on the print as white spots against a black background. The R_F values were determined in the usual way. The R_F values obtained by us are given in Table II along with the values reported by others in brackets.

TABLE II

No.	Solvent system employed	Adenine	Guanine	Uracil	Xanthine
1	2:1 Ethanol—HCl	0.59	0.44	0.75	0.0
2	Ethanol—NH ₃	0.65	0.54	0.72	0.61
3	Propanol—HCl	0.46	0.30	0.66	0.0
4	Propanol—NH ₃	0.67	0.45	0.69	0.52
5	Butanol—5 Urea	0.08 (0.41)	0.12 (0.05)	0.34 (0.35)	0.0 (0.12)
6	Butanol—Ammonia	0.41	0.1	0.27	0.16
7	<i>Is</i> o amyl—Am. citrate	0.63 (0.69)	0.0 (0.50)	0.81 (0.72)	0.0 (0.52)
8	<i>Is</i> o butyric acid—Am. <i>Is</i> o butyrate pH 3.6	0.93	0.70	0.70	0.55

DISCUSSION

From Table II it can be seen that, of all the solvent systems employed, ethyl alcohol-0.5*N*-HCl 2:1 is advantageous over others since, better and more discrete separations of the 3 constituents out of the 4 contained in the mixture, have been secured (see Fig. 1). Further, ethanol is readily available and is less expensive. Equally good separations are obtained with mixtures of *n*-propanol-HCl (2:1). Among other solvent systems studied, the R_F values of a pair of the four constituents employed as a mixture overlap each other, resulting in inefficient separations. If the solvent system is too acidic, xanthine (alkaline soluble) gives a streak. If the solvent system is made alkaline by creating an atmosphere of ammonia, the acid-soluble guanine streaks. *Isobutyric acid*—ammonium isobutyrate at pH 3.6 to 3.7, is the recommended solvent⁹ for separating nucleotides. We have used this solvent mixture for separating the bases, because, it is necessary to determine the positions occupied by the various constituents when a mixture of nucleotides and bases are encountered.

Our studies are confined only to the three bases, ordinarily occurring in nucleic acids. Xanthine, however, has been included. Cytosine, thymine and the related nucleosides and nucleotides have not been readily available for our work. We have, however, attempted a separation of a nucleotide mixture obtained from a baryta hydrolysate¹² of yeast nucleic

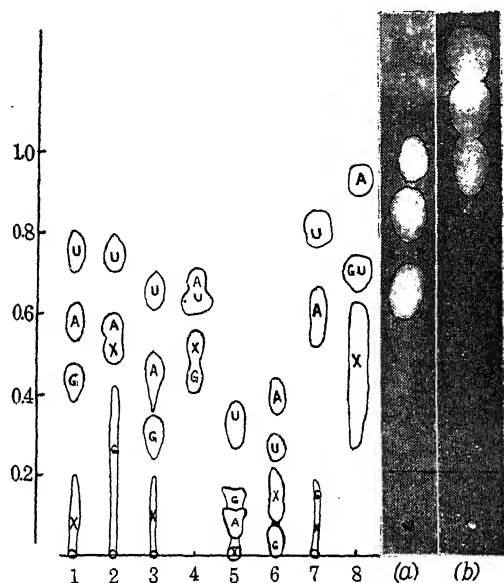


FIG. 1

A—Adenine
G—Guanine
U—Uracil
X—Xanthine

(a) Isobutyric-Am. butyrate.
Three spots in the descending order are adenylic, cytidylic and (guanylic & uridylic).
(b) Developed in Ethanol-Hcl.

FIG. 2

acid (BDH). Papyrograms developed with solvent mixtures of ethanol and isobutyric acid are reproduced (Fig. 2). While we are unable to characterise the different constituents on the papyrogram without the reference spots, the results, however, suggest the possibility of securing better separations of the nucleotides on longer strips with suitably buffered ethanol mixtures. Work in this direction is now in progress.

Our thanks are due to Prof. M. S. Thacker, the Director, for his kind and continued interest, and to the Council of Scientific and Industrial Research for their generous financial aid.

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SOIL CONSERVATION—A VITAL NEED OF THE NATION*

A SAMPLE survey conducted in 1950 in certain parts of Bombay reveals that 71 per cent. of the land has been denuded partially or totally, of which 32 per cent. is wholly unfit for crops. The danger is on the increase and it is imperative that immediate steps be taken to conserve our soil.

The three guiding factors for conservative farming on level land are: (1) building up of soil structure; (2) improvement in soil permeability; and (3) provision of crop cover during the period of heavy showers.

Measures for mechanical means of erosion control involve a careful study of soil profiles, soil permeability and run-off and field trials to determine, suitable types of terraces for different soil zones, terrace spacing, types of waste weirs, etc.

In areas of low and uncertain rainfall, the major problems associated with dry farming are: (1) selection of crops; (2) moisture conservation; (3) improving soil texture by rotations, tillage and fallows; and (4) supplying deficiencies of plant food by manuring. The needs of

the soil under each of these should be carefully worked out for each zone.

The most common features of deterioration in irrigated soils are water-logging, salinity, loss of soil structure and fertility constituents and adverse microbiological conditions. Well planned soil studies based on a correct classification of the soils and a thorough understanding of their nature are an essential prerequisite for the conservation of the soil fertility over a long period by proper adjustment of water, manure and crop rotations. The genetic method of soil classification based on the entire soil profile as the unit of study and other associated experiments, that are being followed, in Bombay, is worth a detailed study in this connection.

Among unproductive soils, the saline soils deserve a special and detailed study, as the potentialities of obtaining good crops after these soils have been properly reclaimed have been amply demonstrated. These may be naturally occurring saline soils in dry areas or soils rendered saline by irrigation. In the Bombay State successful reclamation methods have been worked out both under irrigation and dry cultivation and proper crop husbandry recommended for right land utilisation.

B. DASAPPA.

* Abstract of Presidential Address, by Dr. J. K. Basu, Ph.D., F.N.I., to the Section of Agricultural Sciences, during the 38th Session of the Indian Science Congress, 1951.

THE ROLE OF SALIENTIA IN HUMAN AND MAMMALIAN PREGNANCY TESTS*

IN an exceedingly fascinating address, Dr. Bhaduri described the utilization of frogs and toads as test animals in the determination of early human and mammalian pregnancies. Since clinical tests alone are not satisfactory in early pregnancy diagnosis, it could be made more accurate if supplemented with laboratory biological determinations. Aschheim-Zondek test was the earliest to be proposed and a modification of this by Freedman utilizing isolated virgin female rabbits was in vogue till recently when the female *Xenopus* test became another tool in the hands of gynecologists.

It was Galli Mainini who initiated the use of male toads as test animals and since then, a large amount of literature has grown on the use of this animal for diagnosing early pregnancy. According to Dr. Bhaduri, the technique consists in injecting 1 to 10 c.c. of urine from a woman suspected of pregnancy into the dorsolateral lymph space of a male toad (*Bufo*) whose urine has been previously declared by microscopic examination to be sperm-free. After a lapse of half an hour, the urine of the toad, either taken out by a catheter or made

to void by gentle coaxing, is examined microscopically. The presence of sperms, dead or alive, motile or otherwise would indicate a positive reaction. A confirmation of this may be made again. Should the result be negative, the injection may be repeated a second time and the urine examined. The gonadotropic hormone present in the pregnant human (or mammalian urine) causes the sperms to be produced in the frogs and toads.

The author has used toxic urine with definite results and he has also pointed out that side by side using urine, serum has been tried by various workers but the former has certain advantages.

It is interesting to note that in pathological cases, the author points out that both positive and negative reactions result; in a case which yielded a negative result, it was discovered that the patient aborted three days later. Therefore, it would be worthwhile for the physician to correlate his clinical data with this simple biological test.

Faces of pregnant females and of farm animals have also been successfully used. It is hoped that the frogs and toads which are already martyrs to biological sciences may become more so in view of the recent discoveries in endocrinology.

L. S. R.

* Abstract of Presidential Address, by Prof. J. L. Bhaduri to the Zoology Section of the Indian Science Congress, 1951.

PLANNING FOR PROSPERITY

IN his Presidential Address to the Engineering and Metallurgy Section, Indian Science Congress, 1951 Session, Prof. M. S. Thacker observed that the execution of the power projects and the starting of industries will necessitate the provision of technically trained personnel in large numbers. A beginning to meet this demand has already been made in the establishment of four National Laboratories in the proposed chain of eleven ones, and starting of higher technological institutes under the dynamic leadership of the Prime Minister and the able guidance of Sir Shanti Swaroop Bhatnagar. During the initial stages, close collaboration with foreign technical experts will be necessary, but it is important that initiative in all schemes should invariably be in the hands of the local personnel. Designs of these projects should be such as to make maximum use of local labour and materials.

Institutions like the Indian Institute of Science where such work is already being done should be encouraged by giving further large grants. Research in Power Engineering, Hydraulic Machines Design, etc., are essential if

the multi-purpose projects are to succeed. There should be perfect co-ordination of activities between research and the field executive.

Planning for power and irrigation on such a large scale, presupposes an overall plan to integrate with these other activities to ensure a well-balanced programme of development. The constitution of a National Planning Commission is a step in the right direction. As the chain of projects is under way, it is essential to carry out periodical surveys to obtain an overall picture of progress achieved and to be achieved.

The basic ideas which make possible industrial advancement come out of scientific discovery or creative activity. If the contributions of research were to be reduced, the industries would tend to freeze into a particular pattern and ere long become moulded.

It is up to the scientists and engineers of present-day India, to show to the world that they can, by their efforts, build up a new India, which the other countries of the world will look up to.

N. S. G.

LETTERS TO THE EDITOR

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NEAR U. V. ABSORPTION OF PARA-CHLORO-PHENOL

IN the region 2920A-2680A, about thirty absorption bands have been recorded due to the disubstituted benzene molecule, *para*-chlorophenol in its vapour state. The region of absorption is in general agreement with that observed by Purvis and McClelland.¹ Assuming the electronic transition to be an allowed one, the vibrational analysis of the bands could be carried out with the O—O band located at 2871.0, 34820 and in terms of eight upper state vibrational frequencies; 135, 170, 346, 795, 960, 1053, 1212 and 1450 cm.⁻¹

Comparison of these with the upper state vibrational energies of *ortho*-chloro-phenol,² and also with those of phenol,³ hydroquinone, resorcinol, catechol,⁴ *ortho*-, *meta*-, *para*-cresols,⁵ indicated that the frequency of about 800 cm.⁻¹, found in these spectra, has to be associated with the C—OH vibration as was first remarked by Sreeramamurty.⁵ In *para*-chlorophenol, the band representing the 795 cm.⁻¹ vibration is the strongest (next to O—O) while in the case of *ortho*-chloro-phenol the 953 cm.⁻¹ carbon vibration is very strong.

Bands occurring displaced to the red side of the O—O by approximately 176 cm.⁻¹ and 407 cm.⁻¹ probably represent vibrations in the lower state. A difference frequency of about 25 cm.⁻¹ was also detected.

Full details of the work will be published in the *Proceedings of the National Institute of Sciences of India*. The author is indebted to Prof. K. R. Rao for his interest in the work.

Andhra University, C. RAMASASTRY.
Waltair,
December 27, 1950.

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ON THICKNESS LINES IN RELATION TO THE ONSET AND MOVEMENT OF COLD WAVES IN WESTERN PAKISTAN AND NORTHERN AND CENTRAL INDIA DURING WINTER

PETTERSSEN¹ has shown from theoretical considerations that southerly thermal winds in advance of a sea-level anticyclone or wedge of

high pressure will cause an acceleration in the eastward movement of the high pressure system. This conclusion is based on the assumption that (1) the transport term in the height (pressure) tendency equation can be neglected and (2) the divergence term in the tendency equation is mainly due to the geostrophic thermal wind contribution. In order to test the usefulness of this rule in day-to-day forecasting, the present writer has made a detailed study of two well-marked high pressure systems which rapidly moved across Western Pakistan and Northern and Central India during the following two periods: (1) 8th to 11th February, 1950; (2) 9th to 11th February, 1951.

In the above spells, (a) in advance of the 12 GMT sea-level seasonal high on each of the days, the thickness lines on the 1500 GMT 700 mb. chart (drawn on the basis of the radiosonde data over India and the neighbouring countries and the thermal winds computed from the vector wind shear between the 1000 and 700 mb. levels) ran from south-southwest to north-northeast; (b) during the 24 hours subsequent to the 12 GMT chart on each of the days, there was a rapid eastward movement of a wedge of high pressure and of the 24 hours positive isallobars across Western Pakistan and Northern and Central India; (c) the rapid movement of the wedge of high pressure caused a progressive eastward surge of extra-tropical continental air into Western Pakistan and Northern and Central India and a marked cold spell in these regions. In the spell of 8th-11th February, 1950, sudden and very large drops in minimum temperature amounting to as much as 20°-30° F. occurred in 24 hours in Rajasthan, Madhya Bharat and north Madhya Pradesh.

It is interesting to note that (a) the horizontal pressure gradient at sea-level in the region of the thermal winds in both the above cases, was generally weak and, therefore, the transport term in the tendency equation could be neglected, at least as a first approximation; (b) the region studied lay between 21° N. and 35° N. The isobaric-mean wind between 1000 and 700 mb. in this region did not also exceed 30-40 knots² almost on all the days. It would therefore be justifiable to assume that the thermal wind represented the major portion³ of the vector wind shear between 1000 and 700 mb. It may also be pointed out that the well-known mean meridional cross-sections prepared by Hess⁴ and reproduced by Rossby⁵ are based on the assumption that the geostrophic wind equations can be considered to be valid upto about 12° N. R. A. S. Ratcliffe⁶

has also very recently reported that thermal winds computed from the vertical wind shear (as has been done by the present writer) shows reasonable agreement with geostrophic values even at latitude 10° N. in the Indian area; (c) the periods studied were during winter when the pressure systems which affect Western Pakistan and Northern and Central India resemble those of middle latitudes.

It is realised that no broad generalisation can be made on the study of these two cold spells only. Nevertheless, the fact that the conclusions drawn from Petterssen's rule agree very well with the *observed facts* in these two typical cases, would seem to suggest that the run of the thickness lines in relation to the position of the sea-level high can be used as an additional factor in forecasting the rapid onset and movement of cold waves across Western Pakistan and Northern and Central India in winter.

Fuller details of this investigation together with the daily sea-level charts and thickness patterns during these spells, will be published elsewhere.

Meteorological Office,
Poona 5,
February 23, 1951.

C. RAMASWAMY.

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CHROMATOGRAPHIC SEPARATION OF VAT DYES

In a previous communication methods for the chromatographic separation of water-soluble dyes of the acid, basic and direct cotton classes were outlined,¹ and procedures for the separation of vat dyes have now been developed. A generally applicable method is to vat the mixture of dyes with aqueous tetraethylenepentamine, $\text{NH}_2(\text{CH}_2\text{CH}_2\text{NH})_3\text{CH}_2\text{CH}_2\text{NH}_2$, and sodium hydrosulphite, carry out the aqueous tetraethylenepentamine containing a (80 mesh), and develop the chromatogram with aqueous tetraethylenepentamine containing a little hydrosulphite. One part of the organic solvent and four parts of water are employed

both for adsorption and development. A clear and remarkably stable vat is obtained when a vat dye is made into a paste with tetraethylenepentamine and treated with aqueous hydrosulphite solution at room temperature (23-30°). Employing these conditions, the following mixtures have been separated; the dyes in each mixture are mentioned in the order of increasing adsorbability, the last dye being at the top of the column: (1) Caledon Gold Orange G and dibenzanthrone; (2) Caledon Yellow 3G and Caledon Brilliant Purple 4R; (3) Caledon Yellow 3G, Caledon Jade Green, Caledon Red BNS and dibenzanthrone. Diethylenetriamine and triethylenetetramine are less satisfactory than tetraethylenepentamine; morpholine and ethylenediamine have more limited scope, and can only be used for the separation of pairs of dyes which differ widely in their substantivity to cellulose (e.g., Caledon Yellow 3G and Caledon Brilliant Purple 4R). *n*-Butylamine, which has been recommended as an effective solvent in conjunction with hydrosulphite for stripping vat dyes,² gives a clear vat in the absence of caustic soda, but *n*-butylamine is less effective than tetraethylenepentamine in separating a mixture of vat dyes by chromatography on a cellulose column.

Brown³ has described a method of adsorption separation on paper which he used for separating green leaf pigments from a carbon disulphide solution. A sheet of paper is placed between two glass plates (e.g., 6 inches square). The cover plate has a small hole (3/16 or 1/4") at the centre. A solution of the mixture is added dropwise through the hole, followed by the solvent; the components travel outwards in concentric zones, and clear separation of certain mixtures can be effected in this manner. Brown's technique can be applied to vat dyes by using aqueous tetraethylenepentamine and hydrosulphite, both for vatting and development. The only disadvantage of the filter-paper and glass plate technique is that an outer yellow band of tetraethylenepentamine appears when the filter-paper is dried.

The procedure we have described for the separation of direct dyes on cellulose acetate, nylon or vinyon¹ can be modified for application to vat dyes. A suitable fabric is Lumite, which is woven from Saran of filament diameter 0.008" and mesh construction 120 × 56. The fabric is activated by immersing in dioxane at 50° for one hour, rinsing with saturated sodium chloride solution, and drying; the

fabric shrinks and the natural yellow colour is bleached. When a few drops of a solution of a mixture of vat dyes (e.g., Caledon Red X5B and Caledon Jade Green) in concentrated sulphuric acid are placed on the fabric, followed by a few drops of the acid, separation takes place.

It has been claimed that vat dyes in nitrobenzene solution can be separated on alumina,⁴ but most vat dyes are insoluble or very sparingly soluble in nitrobenzene (and other organic solvents) in the cold. Conflicting statements on the separability of alkaline vats on alumina have been made.^{4,5,6} Vat dyes reduced by aqueous caustic soda and hydrosulphite have been chromatographed on columns of bleached sawdust or disintegrated cotton; the chromatogram was then developed in the colours of the oxidized dyes by means of potassium ferricyanide solution.⁴ The rate of flow through paper pulp was found to be too slow.⁴ In our experience it is only a mixture of dyes of widely different substantivity to cellulose (e.g., α -benzamidoanthraquinone and dibenzanthrone) that can be separated by this method. A mixture of dyes such as Caledon Jade Green and dibenzanthrone does not undergo clear separation from an aqueous caustic soda-hydrosulphite solution on filter-paper. Even in the former case we have observed that the addition of ethanol or pyridine is useful, since it stabilizes the vat and cuts down the substantivity. By the addition of an equal volume of pyridine to the aqueous caustic soda-hydrosulphite vat and by using a 1 : 1 mixture of water and pyridine containing caustic soda and hydrosulphite for development, the following mixtures have been separated on filter-paper by the glass plate technique; the dyes are mentioned in the order of increasing adsorbability: (1) Caledon Jade Green and dibenzanthrone; (2) Caledon Yellow 3G and dibenzanthrone; (3) Caledon Gold Orange G and Caledon Brilliant Purple 4R. A slight modification by adsorbing from aqueous alkaline hydrosulphite solution and developing with a 1 : 1 mixture of water and pyridine containing caustic soda and hydrosulphite is useful for the separation of certain mixtures (e.g., Caledon Red BN and Caledon Gold Orange G).

We are indebted to the Council of Scientific and Industrial Research for the award of a Fellowship to one of us, to Dr. R. V. Bhat of the Forest Research Institute, Dehra Dun, for preparing cellulose powder, and to the Dow Chemical Co. and Chicopee Manufacturing

Corporation of U.S.A. for the supply of Lumite.

Dept. of Chem. Tech., N. R. RAO.
Univ. of Bombay, K. H. SHAH.
Bombay 19, K. VENKATARAMAN.
February 7, 1951.

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COLOURATION OF HYDROGENATED FATS WITH CHLOROPHYLL TO PREVENT ADULTERATION OF GHEE

WITH a view to preventing adulteration of ghee with hydrogenated fats, the colouration of the latter with a number of organic colouring matters has been tried, but none of them has been considered to be suitable for one reason or other. It has now been found that chlorophyll can be satisfactorily used for colouring hydrogenated fats so as to prevent their use as adulterants of ghee. In actual practice, it is not necessary to use the chemically pure pigment, the total chlorophyll extract serving the purpose amply well. It is found that the use of 1 lb. of the pigment for every 1,000 lbs. of fat imparts a pleasant yellowish-green colour giving 30 yellow and 4 blue in a Lovibond Tintometer in a $\frac{1}{2}$ cm. cell.

Chlorophyll is available in any quantity and is perfectly edible. Besides not being harmful it is stated to act as an oxidation catalyst in the metabolic processes of the human body, being the "life-giving substance (which) is probably the answer to the prayer for prolonging the useful span of life."¹ It has the further advantage of being easily detected by the red fluorescence of the melted fat in sunlight or more prominently in the ultraviolet light. A suitable source for the extraction of the pigment is the leaves of the common vegetable plant *Spinacia oleracea* Linn. (Spinach or Palak) which gives 5 per cent. of the crude pigment from the dry leaves (8 per cent. moisture). Other convenient sources are the leaves of the forest plants, *Urtica parviflora* Roxb. (Indian Stinging Nettle) and *Clerodendron infortunatum* Gaertn. which give 3.5 per cent. of the pigment. From these materials the pigment is easily extractable by the method

of Willstatter and Stoll² using 80 per cent. acetone or 90 per cent. alcohol.

A sample of the fat coloured with chlorophyll cannot be used for adulteration, since its presence in ghee in as low a quantity as 10 per cent. can be easily detected by the marked greenish tinge. Any attempt to decolourise the "chlorophyllised fat" by heat or exposure to sunlight with a view to using it as an adulterant will not be successful, since the sample does not get completely decolourised but becomes only discoloured and exhibits a marked deep red fluorescence in ultraviolet light or even sunlight. Also such samples very readily respond to a microchemical test³ for magnesium which is present in the chlorophyll molecule. By this test it is possible to detect chlorophyllised vanaspati even to the extent of 1 per cent. in pure ghee. Although chlorophyll, like any other pigment, is almost completely removed by treatment with animal charcoal or Fuller's earth, yet even the little that remains in the fat clearly responds to the fluorescence test. Further such treatment is too difficult and costly to be practised profitably on a large scale.

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Dehra Dun, P. RAMACHANDRA RAO.
December 26, 1950.

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ROT OF MANGIFERA INDICA LINN. CAUSED BY ASPERGILLUS

OUR attention was drawn towards lesions on mangoes observed year after year in several orchards in Lucknow and other districts. About 25 per cent. of the crop of the varieties, *Dasehri*, *Amin*, *Mohanbhog*, *Tukhmi*, *Khajli*, *Gola* and *Safeda*, are usually affected; the last two are particularly susceptible.

The first external symptom is a yellowing of the region. Then some irregular, hazy, greyish spots appear which coalesce to form a dark-brown or black spot, 1-1½ cm. in diameter. Usually the basal part of the fruit is affected but cases have been observed where other regions have been involved. Rarely it may be lateral but it has never been found at the tip (Fig. 1). In advanced cases the lesion shows a depression and softening of the meso-

carp while the remaining portion is quite hard. When the disease occurs at the stalk end, there is a premature falling of the fruits.



FIG. 1. [A] Diseased Fruit of the Safeda variety

A transverse section of the diseased portion showed that the epicarp, mesocarp and the endocarp were affected. Besides softening into a pulpy mass the mesocarp assumed a brown colour and showed the presence of hyphæ and spores under the microscope. Hyphæ are present in the cells of the stalk upto approximately 4" from the point of attachment.

Isolations were made from the infected tissues under sterile conditions and almost invariably, uncontaminated growth of *Aspergillus*, identified as *A. niger*, was observed. Fruits of different varieties on trees were inoculated after the method devised by M. Kay¹ by putting the inoculum on the injured surface and covering it with sterile paraffin wax. It was found possible to reproduce the normal lesions. A fungus morphologically alike was reisolated from the experimental fruits.

It remains to be seen how the fungus enters the fruit. Most likely it enters through a wound caused by the crawling of insects or by pecking of birds from where the hyphæ traverse into the stalk region.

Das Gupta and Bhatt² have reported latent infection of mangoes by *Aspergillus* spp. including *A. niger* causing rots during storage. As far as known to the authors this is the first record of the disease in Nature.

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August 25, 1950.

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HORMONE INDUCED PARTHENO-CARPY IN *HIBISCUS ESCULENTUM* AND *SOLANUM MELONGENA*

Two techniques for the application of hormones have been followed, viz., (a) spraying, and (b) hormone paste.

Hibiscus esculentum.—The fruits under study were at the pre-anthesis, anthesis, and post-anthesis stages. The selected flowers were emasculated and the stigma removed. In those cases which were sprayed with 0.01% methyl naphthoxy acetate, 4 times at intervals of 24 hours, the fruits dropped off soon after setting. Therefore, in the subsequent experiments the flowers were sprayed only once.

The experimental findings are given below:

Pre-anthesis.—Sprayings with 0.5% Indole butyric acid, 0.01% methyl naphthoxy acetate and 0.1% chlorophenoxy acetic acid showed entirely seedless development of the fruit. The fruits attained almost the normal size. In the case of Indole butyric acid, however, the fruits were less fibrous and remained green for a long time [Fig. 1 (B)].

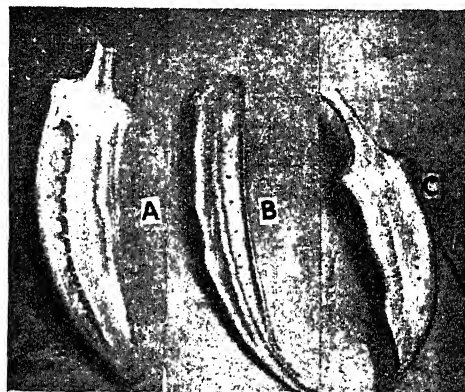


FIG. 1

Application of hormones at Pre-anthesis stage.

(A) 0.25% 2,4 dichlorophenoxy acetic acid applied as paste.

(B) 0.5% Indole butyric acid applied as spray.

(C) 0.25% Indole butyric acid plus β -naphthoxy acetic acid applied as paste.

The hormone paste was applied on the cut end of the style with a dissecting needle without smearing it round the ovary wall, which was found to damage the fruit.

The application of α -naphthalene acetic acid as paste in all concentrations, viz., 0.05 to 1% resulted in the dropping-off of the fruit at an early stage. 0.1% of β -naphthoxy acetic acid, 0.05% and 0.1% chlorophenoxy acetic acid,

0.25% 2:4-dichlorophenoxy acetic acid and 0.25% Indole butyric acid plus β -naphthoxy acetic acid give satisfactory results, and resulted in the development of the fruits [Figs. 1 (A, C) and 2 (B)]. All these fruits, however, remained slightly smaller than the control.



FIG. 2

(A) Control

(B) 0.1% B-naphthoxy acetic acid applied as paste at per anthesis stage.

Anthesis.—The same concentration of hormones was given as earlier. The results show that the fruits developed were of the same size as the control and larger than the fruits treated at the pre-anthesis stage. It was also noticed that some fruits were partly seeded. Some of these seeds were of normal size. It is presumed that in some cases fertilization must have taken place before emasculation, resulting in partial seed formation.

There was one significant point of difference between the anthesis and pre-anthesis stages, viz., whereas in the latter case, α -naphthalene acetic acid in all concentrations had harmful effect, in the former case 0.1% and 0.2% produced the same effect as those with the other chemicals mentioned.

Post-anthesis.—The work on post-anthesis was not connected with the production of seedless fruit but was mainly directed to find out the sizes of the fruit. It was noticed that after the application of 0.1% and 0.2% α -naphthalene acetic acid, 0.05% and 0.1% chlorophenoxy acetic acid and 0.25% 2:4-dichlorophenoxy acetic acid the sizes of the fruits developed to a greater extent than the control.

With regard to the sizes of the fruit, Gustafson¹ (1939) has expressed the view that in the case of tomatoes the difference in size must be due to the smaller cells in the parthenocarpic fruits than in the seeded fruits. Our experi-

ment supports Gustafson's view indirectly. If we assume that cell expansion is brought about by the agency of auxin from pollen as also by the specific chemical hormones applied, then at the post-anthesis stage the fruits will receive a larger dose of the mixed hormones resulting in bigger-sized fruits. At the anthesis stage the fruits were of normal size, this may be due to the cumulative effects of (a) hormones applied to the flower, and (b) the auxins supplied to a limited extent by fertilization of a limited number of ovules. The smaller-sized fruits, at the pre-anthesis hormone-treated fruits, show that the development of the ovary depended entirely upon the chemical hormones applied. If the quantity of auxin present is responsible for the size, it would seem possible to increase the size of the parthenocarpic fruits by supplying them with more auxin. Methods for doing this will have to be developed as it is not sufficient merely to smear more hormone paste on fruits, which may be injurious.

Solanum melongena.—In the case of *S. melongena*, the investigation was carried out only at the pre-anthesis stage, the bud being subjected to the same hormone treatment as in the previous case.

The buds were sprayed with 0.01% and 0.001% methyl naphthoxy acetate. The hormone paste used was 0.2% α -naphthalene acetic acid. The fruits so produced were seedless. Besides, their bases were broader, circular, and tapering sharply towards the apex.

Further work is in progress.

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MISS RAVINDER KAUR.

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September 16, 1950.

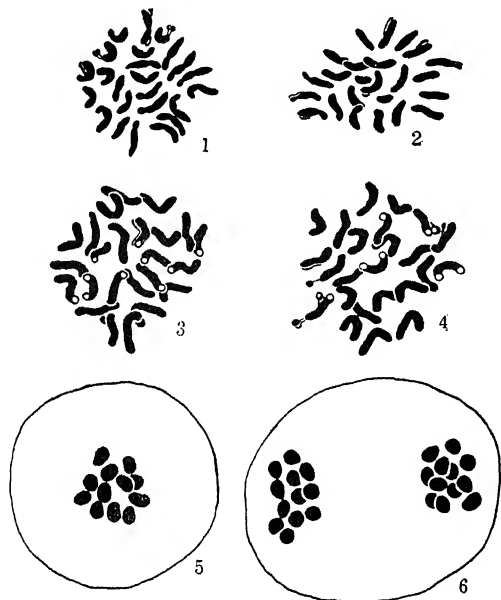
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CHROMOSOME NUMBER AND MORPHOLOGY IN *PHYSALIS*

ACCORDING to Darlington and Janaki Ammal,¹ the species of *Physalis* are all diploids with 24 somatic chromosomes excepting *P. minima*

which has $2n = 48$; but counts by different authors differ. For example, in *P. peruviana* and *P. angulata* besides the diploid number, $2n = 48$ has been reported by Vilmorin and Simonet⁴ and Yamamoto and Sakai.⁵ Later, $2n = 48$ in *P. pubescens* also was reported by Tokunaga.³ Such differences in chromosome number give indication of polyploid forms existing within some of the species. With this idea the present author undertook a revised cytological study of some of the species. The important observation are described below:

For examination of the somatic chromosomes, root tip sections were obtained from *P. peruviana*, *P. pubescens*, *P. alkekengi* and *P. Francheti* all of which showed $2n = 24$ (Figs. 1 to 4). Counts for the unrecorded species *P. lanceifolia* and *P. ixocarpa* were made from the first and second metaphases of the dividing pollen mother cells (Figs. 5 and 6) which showed the haploid number to be twelve in each case. Thus no sign of polyploidy could be detected.



From the somatic plates, it can be seen that the chromosomes of *P. alkekengi* and *P. Francheti* are different in size and morphology from those of *P. peruviana* and *P. pubescens* which also differ from each other slightly. In the former two species (Figs. 3 and 4), the chromosomes are larger and the spindle-attachment region, except in a few cases, is not clear; but probably it is either median or sub-terminal. In the somatic metaphase plate of *P. alkekengi* represented by Nakajima² also, the chromo-

somes appear to be large and without any apparent constriction. Constrictions in *P. peruviana*, on the other hand, are well-defined and less so in *P. pubescens*. Nearly half the number of chromosomes in *P. peruviana* are secondarily constricted and the rest have either median or sub-median attachment. In *P. pubescens*, however, secondary constriction is clearly observable only in one pair. The remaining chromosomes, of which there is one pair of the smallest size, have either median or sub-median attachment. No satellites were seen in *P. pubescens* and *P. alkekengi* whereas two chromosomes were satellited in each of the other two.

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October, 1949.

N. P. SINHA.

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A DOUBLE-BLADE METHOD FOR MAKING GOOD SECTIONS

HAND sectioning of succulent materials is generally accomplished by the help of pith, but by this technique the material gets crushed or distorted, and satisfactory sections are difficult to obtain. In the following method, a good section can be got easily without spoiling the shape or wasting much of the material, time and energy:

1. Clean cut pieces of cucurbita fruit, carrot or any other "pith" even a plane surface of a glass slide will serve as a suitable base.
2. With two sharp safety-razor blades held together firmly between the index finger and the thumb, cut firmly and quickly (crosswise or lengthwise as required).
3. A fine section is obtained (by a stroke or two) in the space between the edges of the blades.

The advantages over the usual razor method are: (1) Economy of material, energy and time; (2) Relatively better sections; (3) Sections at the desired spot; (4) Easy handling of the material; (5) Sections can be taken by any person with very little previous practice;

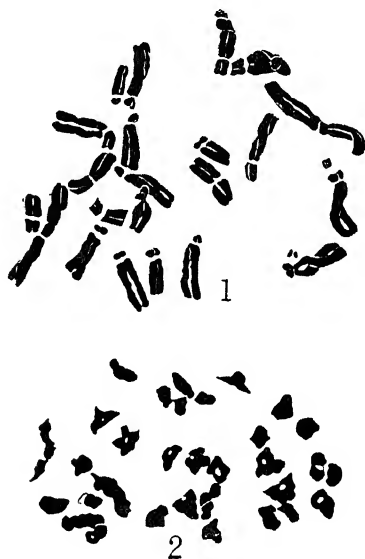
(6) Method especially useful for succulent, submerged, pulpy parts and thin leaves.

This method, after a fair trial in our laboratory, was found to give satisfaction.

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CYTOLOGICAL STUDIES IN *OTTELIA*

Ottelia alismoides was reported to exist in diploid, tetraploid and hexaploid chromosome races with a basic number 11 (Sundar Rao, 1950). It was added that the 22 somatic chromosomes of the diploid race show distinct morphological features (Fig. 1). The hexaploid is characterised by regular formation of 33 bivalents in the PMCs (Fig. 2). The regular disjunction and the absence of multivalents during meiosis indicate the allopolyploid nature.



In certain morphological features, like the shape of the leaves and the size of the pollen grains, the diploids differ from the polyploids. While the diploids have white flowers, those of the hexaploids are either white or pink. Though not always absolute, the hexaploids show gigantism which is particularly manifest when diploids and polyploids occur together in the same pond. Whenever it is so, the diploids are marginal and the polyploids are deep water forms.

Closely related to the bisexual *Ottelia* is the unisexual *Boottia* spp., which showed a remarkable similarity to hexaploid *O. alismoides* in chromosome number and morphology. This fact lends support to Dandy's view (1934) of the amalgamation of this genus in *Ottelia*. During the present investigation, certain hexaploid bisexual forms resembling unisexual *Boottia* spp., were collected. They probably strengthen Dandy's view and serve as connecting links between *Ottelia* and *Boottia*.

Thus it is clear that there are two evolutionary tendencies in the genus: (i) a bisexual condition as in *O. alismoides* with diploids tetraploids and hexaploids; (ii) a unisexual and probably polygamous (?) condition as in *Boottia* with only hexaploids. The latter probably arose as an off-shoot from the former at a hexaploid level. According to this view, the ancestral forms of *Boottia* might be hermaphrodite diploids and unisexuality is a later stage in evolution.

Polyploidy is responsible for the wide range of geographic distribution of *O. alismoides* in south-east Asia, eastern tropical Australia and north-eastern Africa. A study of the geographic distribution of the polyploid races of *O. alismoides*, particularly in India, revealed that S. India is the region of greatest variation in having diploids, tetraploids and hexaploids and it is equally significant to observe the absence of the diploids in N. India. Morphological variation similar to S. Indian forms was encountered in the herbarium sheets of the Malayan forms of the species. Apparently, diploids and polyploids also occur in this region. Hence, it may not be wrong to conclude that *O. alismoides* originated in such tropical regions like S. India and Malaya and then migrated to the northerly parts in the range of distribution. In this connection, it is interesting to note that the specimens from China and Australia also look like polyploids.

Grateful thanks are due to Prof. A. C. Joshi, Dr. N. Parthasarathy and to Mr. J. Sinclair, Botanic Gardens, Singapore, for help in various stages of the investigation and to National Institute of Sciences of India for the award of a Junior Research Fellowship.

Kakinada,
December, 18, 1950.

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A MUTANT IN ASIATIC COTTON

SEEDS of three pure lines of Asiatic cotton belonging to *G. herbaceum* var. *acerifolium* HSS and *G. arboreum* race *indicum* HSS were irradiated by X-ray from a molybdenom target at 50 KV, 10 ma and 15 centimetre distance for time intervals of 10, 15, 20 and 30 minutes. The plants raised from the treated seeds did not show any change during the first year while one of the progenies of strain 546 from *G. arboreum* race *indicum* HSS irradiated for 10 minutes, had narrow leaves in the second generation. The new variant accessed as SX 507 in the breeding records, was not different from the parent stock in any manner except for the change in the mean values of leaf index which increased from 2.5 to 4.0, and bred true in the succeeding generations.

The inheritance of the narrow leaf mutant SX 507 was studied in crosses made with the parent strain 546. The leaf indices adopted in

not possible at this stage to say which of the two hypotheses is correct.

The occurrence of the mutant progeny in the second year will be a normal one, if the change is viewed as *I* to *i* but if it is to be explained as a dominant one, the mutation must be regarded as having occurred in a somatic cell affecting both chromosomes, possibly late, just prior to flowering as otherwise the change in leaf lobing must have been noticed in the first generation itself. The strain 546 must have been highly mutable since it yielded new mutants like meristic variant (*m*)³ and chlorophyll deficient xantha (*chl₂*)⁴ when it was irradiated by X-ray twice before. Types belonging to *G. herbaceum* var. *acerifolium* HSS on the other hand were more stable and gave only one mutant albino (*chl₁*)⁴. The comparatively larger variability and the numerous races and varieties of *G. arboreum* HSS are probably the result of such small changes induced by severe stress of new environments

Name of parents	Generation	Total plants observed with indices			Value of 'P' greater than
		<i>ll</i> 2.3 to 2.7	<i>Ll</i> 2.9 to 3.5	<i>LL</i> 3.7 to 4.3	
Broad leaf Strain 546	..	8			
Narrow leaf Mutant SX 507	..			8	
SX 507 × 546	F 1		2		
Do	.. Backcross to 546	8	6		0.50
Do	.. Backcross to SX 507		10	9	0.80
Do	F 2	58	115	48	0.30

interpreting the data were the arithmetic means of index $A/C + \text{index } A/D^2$. The F1 was intermediate; the two backcrosses gave equal proportions of parental types; and the second generation yielded 1 : 2 : 1 ratio. The summary of the results is given in the above table.

The behaviour is in all respects identical with the one recorded by other workers for factor pair *L* — *l*² in Asiatic cotton series. On this hypothesis, the mutant SX 507 must be interpreted as one in the dominant direction. Since however, almost all the induced mutations recorded in crops have been recessive, the possibility of explaining the inheritance satisfactorily on any alternative hypothesis will also have to be examined. The data will admit interpretation on the basis of a dominant inhibitory factor *I* present in strain 546, mutating in the recessive direction to *i* in SX 507 and having a graded effect according to dosage. As no crosses between mutant *i* and other narrow leaf *L* types have been made and studied, it is

under which man has been constantly trying to expand cotton growing for his own ends in the past.

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Agric. College & Res. Inst.,
Coimbatore,
December 25, 1950.

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THE ENDOSPERM IN CROTALARIA

THE occurrence of a free nuclear tubular process in the chalazal part of the endosperm was recently reported in *Cassia Tora*, a member of the Cæsalpiniaceæ.¹ A similar organisation of the endosperm has been observed in several species of *Crotalaria* belonging to the Papilionaceæ. The embryo-sac, after fertilisation,

enlarges considerably growing particularly in length and is soon filled up with a large number of free endosperm nuclei. The nucellus which is massive along the sides and in the chalazal region, is gradually crushed on account of the extensive growth of the embryo-sac, and this results in the formation of a cavity towards the broad chalazal end of the developing seed. Cell formation in endosperm commences late in the micropylar region when

ed considerably and occupies the major portion of the seed cavity. The tubular free nuclear portion with its enlarged lower end is found lying twisted and compressed in the free space below the cellular zone. In later stages, it gets completely crushed. The cellular portion of the endosperm is gradually consumed by the developing embryo which in the mature seed occupies the whole of the seed cavity.

The entire embryo-sac can be easily taken out of the developing seeds in various stages of development (Figs. 1, 2), and the whole mounts show clearly the chalazal tubular process. A detailed account of the development of endosperm in several species of *Crotalaria* is being published separately.

My sincere thanks are due to Prof. P. Maheshwari of the Delhi University for his valuable suggestions.

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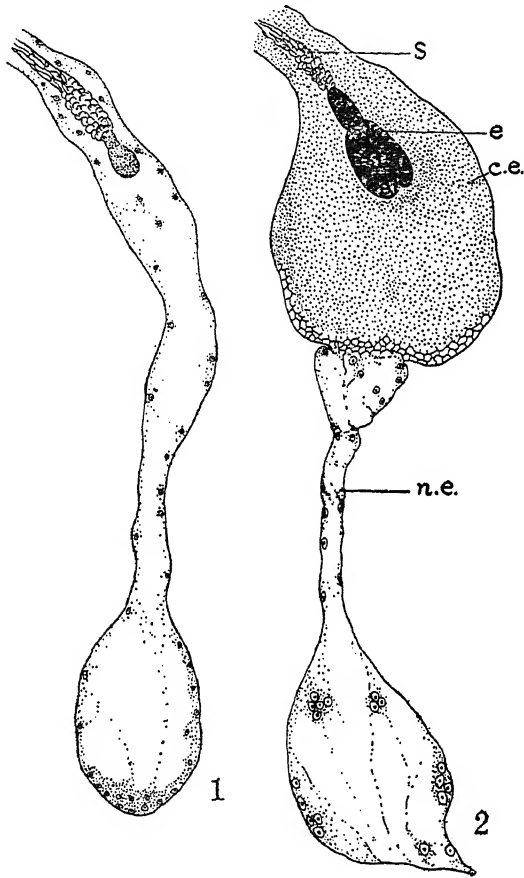
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A PRELIMINARY NOTE ON RICKETTSIOSIS IN SHEEP AND GOATS IN BOMBAY STATE

THIS is a preliminary report on an original observation of the author on the incidence of Rickettsiosis in sheep and goats in Bombay State.

The causative organism has been recognised as "Rickettsiae", inhabiting the tissues of Arthropods which act as vectors. In South and West Africa two species of the organisms, viz., *Rickettsia ruminantium* (Cowdry) and *Rickettsia ovina* have been reported to cause "Heart Water" disease and febrile illness in sheep and goats, but not much work seems to have been done by way of epidemiological, serological and pathological investigations.

The author detected the disease first in a 'merino ram' on the Sheep Breeding Research Station at Suttati (Belgaum), in July 1949. The animals suffered from febrile illness and Rickettsia-like bodies were detected in the monocytes of its circulating blood, which were later confirmed by Dr. H. N. Ray of I.V.R.I. The ticks on the body of the ram (*Hæmaphysalis bispinosa*) were found to be carriers in animal tests, since the tick emulsion in normal saline injected subcutaneously produced similar syndrome of symptoms in a healthy sheep and a healthy goat. Also the blood of the diseased ram was observed to be infective to guineapigs



FIGS. 1, 2. *Crotalaria verrucosa* Linn. Fig. 1. Whole mount of embryo sac which has elongated considerably showing the embryo and free nuclei of endosperm. $\times 40$.

FIG. 2. Whole mount at a later stage showing the cellular and free nuclear zones of endosperm. $\times 16$.

(s, suspensor; e, embryo; c.e., cellular zone of endosperm; n. e., free nuclear zone.)

the embryo has reached a fairly advanced stage in its development. The chalazal part of the embryo-sac, however, remains free nuclear and is formed into a narrow tubular process which has an enlarged lower end. A considerable number of large free endosperm nuclei are found in the tubular portion whose enlarged lower end is in intimate contact with the chalazal tissue. The cellular portion of the endosperm in the mean time will have extend-

as could be observed from the thermal and scrotal reactions depicted by the healthy guineapigs. Rickettsia were recovered in the blood of experimental sheep and goat as well as in the tunica vaginalis and peritoneal scrapings of guineapigs. This has been mentioned in the Annual Progress Report of 1949-50 of the I.C.A.R. Scheme for the investigation of the diseases in sheep and goats in Bombay State. Peculiar and typical variations in temperature were recorded in the naturally affected and experimental sheep and goats and also in guineapigs.

Detailed findings will be separately reported on completion of the investigations.

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January 5, 1951.

ON THE BIOLOGICAL OXIDATION OF SEWAGE

IN continuation of earlier studies,¹⁻⁴ it was observed that aerobic conditions and oxidation changes were promoted in sewage filtered through soil, and that the micro-organisms developed during successive replacements of the soil filtrates (in shallow basins, by the fill-and-draw method) were mainly aerobic bacteria, ciliate protozoa including peritrichous ciliates, e.g., species of *Epistylis* and *Opercularia*. and higher organisms such as species of Rotifers. Similar observations were made with 'weak' and 'diluted' sewages as with the soil filtrates, but the development of the colonial ciliates was slow in the former cases. All these

types of organisms (including occasionally still higher organisms, e.g., *Aulophorus* sp.) were found to develop rapidly in unfiltered sewage into which air was bubbled. In addition to these organisms, species of *Carchesium* were also noticed in certain activated sludges (e.g., from the Plant at Ambasamudram). Observations showed that among the micro-organisms studied the ciliates were the most efficient in producing effluents of the highest degree of purity.

The occurrence of species of *Opercularia* in sewage under aerobic conditions and in activated sludge lends further evidence to the importance of peritrichous ciliates in the purification process. There seems to be no record about *Opercularia* in the literature bearing on ciliates in India, Burma and Ceylon.^{5,6}

The author's thanks are due to Dr. B. R. Seshachar for the confirmation of the identification of *Opercularia* sp.; and to Dr. G. J. Fowler for his keen interest in the work.

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DIRECTORY OF INTERNATIONAL SCIENTIFIC ORGANIZATIONS PUBLISHED BY THE UNESCO

THE Directory, which contains 240 pages, groups the International Organizations in three main chapters—basic sciences, applied sciences, and miscellaneous. The applied sciences are subdivided to cover the agricultural, engineering and medical sciences. Under miscellaneous are to be found such bodies as the International Union for the Scientific Study of Population, the International Federation of Library Associations, and the International Scientific Film Association.

At the end of each chapter, under the heading "Regional", are organizations whose activities are limited to a particular geographic area, as for example the European Federation of Agriculture, and the Pan-American Institute of Geography and History.

Under the separate headings, the following particulars are given: a brief outline of the

aims of each organization and information on its special activities; information on the governing bodies and officers and members; a list of the Member States or national organizations and individual members; commissions set up within certain organizations with details of their work; special facilities of certain organizations, such as laboratories and museums, financial resources; the frequency of meetings; provisions governing voting procedure; a list of the periodicals and documents published; relations with the U.N., Specialized Agencies, and other international bodies; an outline of the organization's history; and miscellaneous information, such as date and place of forthcoming congresses.

The Directory is published in English and French. The cost per copy is 6 shillings.

REVIEWS

The Effect of Atomic Weapons Prepared under the direction of the Los Alamos Scientific Laboratory and published by McGraw-Hill Book Company, 1950. Pp. x + 456. Price \$3.00.

As the Director of the Civil Mobilization Office (U.S.A.) has stated in the Preface, this book contains a detailed description of the physical phenomena associated with atomic explosions and provides certain basic data which will be helpful in the preparation of practical plans for atomic warfare defences.

The amount of energy produced in the fission of 1 kg. of uranium 235 or plutonium is equivalent to 2×10^{13} calories or 20,000 tons of T.N.T. This corresponds to the energy of the atomic bombs dropped over Japan. At the instant of explosion, the core temperature may be of the order of 1 million degrees, which starts an expanding ball of fire which at 1 millisecond after zero time may have a radius of 45 ft. and a temperature of 300,000°. Below this temperature the shock wave advances more rapidly than the isothermal sphere. At the lapse of a second, the ball of fire attains the radius of 450 ft. but the shock front is 600 ft. further ahead. Here the overpressure may be higher than 100 lbs. per sq. inch. After ten seconds, the shock wave has travelled 12,000 ft. and has passed the region of maximum damage. Scaling laws apply to such explosions. Hence from a specific atomic explosion, whose state variables, i.e., pressure, temperature and density, can be written as functions of radius and time, the characteristic features of another explosion can be estimated provided the relative releases of atomic energies are known.

The nature of the fire ball and the shock waves for bursts in the air, on the surface of the sea or earth, or under the sea has been fully described, and the destruction caused by them fully illustrated with photographs.

The effect of radioactive contamination after an explosion has been examined over a number of years; it has been found that even in the most heavily contaminated areas the average dosage rate fell to .3 roentgen per day after a year. The conclusion is drawn that for 1 kg. atomic explosion protection against blast, initial radiation and thermal radiation become practical at a half-mile from ground zero; and that proper precautions may result in a sharp drop

in deaths and damage beyond 3,000 ft. or so. Valuable suggestions have been made regarding the nature of these precautions.

Now that many people are thinking seriously about a third world war, this book should be carefully read by all those who are in charge of civil defence and air-raid precautions.

J. C. G.

Modern Gas Turbine. By Arthur W. Judge. Second Edition, Revised. (Chapman & Hall, Ltd., London, 1950. Pp. xii + 388. Price 32 sh. net.

The book under review was first published in 1947 and now appears in its second revised edition, bearing testimony to the rapid development of the gas turbine in every field of its application. It gives a very complete and up-to-date picture of the present situation. Moreover, the book offers a very good introduction to the underlying principles of thermodynamics, which are illustrated by reference to practical applications.

Together with a history of the development of the gas turbine which appeared in industry first as an auxiliary unit to the Velox boiler and other thermal installations, the thermodynamic fundamentals are explained very vividly. Due reference is also made here to the first application of the gas turbine as an exhaust turbine in combination with piston engines either of the Otto or the Diesel principle. The pros and cons and the inherent limitations are outlined in the second chapter and a more precise and advanced outline of technical thermodynamics is given in the next chapter. Mention is also made of the combination of the rotary with the oscillating type of heat engine, which is regarded as more and more essential for a certain range of power. The efficiency of the gas turbine and possible effects thereon are discussed in the next two chapters and due consideration is given to the many variables which enter the discussion, such as blade cooling, compounding, reheating, etc. While discussing the closed cycle, valuable information is given regarding power plants which have already been built or which are in preparation now and this scheme is compared with the open cycle. Some mention however could have been made here of the semi-closed

cycle which is discussed later. A whole chapter is devoted to the details of exhaust turbines and their combination with normal piston and especially aero piston engines. A very interesting chapter outlines the aero gas turbine and the principles of air-craft propulsion where the German designs have been mentioned, and also burners and atomizers. The next chapter is devoted to some typical power plants in all fields of application, stationary and non-stationary. Of more than general interest is the chapter on materials for gas turbines and their properties, especially with respect to effects of high temperature, corrosion and scaling. The last chapter reviews recent advances and developments and describes power units of recent design. Some emphasis is placed here on auxiliaries for turbine units such as the fuel system. In two appendices, remarks are made on blade design and blade fixing methods.

The book gives a large number of references, which are of help to the professionally interested reader. It would have been of advantage if the book could have given more attention to the underlying engineering sciences, such as to the principles of heat transfer, and the effects, say, on heat exchanger design. The theoretical aspects of different turbine schemes are discussed in Chapter XI and could have been combined with similar considerations earlier in the book. The same holds for the descriptive part of the book where information on a particular turbine scheme is being found in different chapters. The chapter on exhaust gas turbines could be made shorter, especially since the term 'gas turbine' denotes normally and conveniently a power unit working on its own rather than an auxiliary unit, as is the case with turbosuperchargers.

The book, in short, gives all necessary information to the technical reader who is interested in the fundamentals, the present position, and the future development of the most modern prime mover.

H. A. HAVEMANN.

Dirichlet's Principle, Conformal Mapping and Minimal Surfaces. By R. Courant. (Interscience Publishers, New York), 1950. Pp. xii + 330. Price \$4.50.

The name '*Dirichlet's Principle*' was given by Riemann to the assertion that the integral

$$D[\phi] = \iint_G (\phi_x^2 + \phi_y^2) dx dy$$

is minimised by a uniquely determined function ϕ with prescribed boundary values. Ever

since Hilbert succeeded in proving the existence of a solution of the minimum problem by direct construction, the fascination of Dirichlet's Principle has proved a powerful stimulus for the development of the so-called direct methods of the calculus of variations. This development we owe mainly to Courant who, along with his collaborators, has set up and successfully pursued a programme of using Dirichlet's Principle as a basis for developing general methods of the calculus of variations. The beauty and fruitfulness of this approach may be seen on the one hand in the solution by variational methods of the boundary- and eigen-value problems for elliptic partial differential equations of the second order (*vide*: Courant & Hilbert—*Methoden der Mathematischen Physik*, Bd. II), and on the other in the solution given by Courant not only of the original Plateau problem but also of Douglas' general problem and of related problems on conformal mapping, which forms the subject-matter of the book under review. Here we find a unified account of various investigations relating to minimal surfaces and conformal mapping, treated by variational methods using Dirichlet's Principle. A discussion of this principle and its applications to conformal mapping (Chapters I, II) prepares the way for a thorough treatment of Plateau's problem for simply connected minimal surfaces with prescribed boundary (Chapter III) and Douglas' general problem of a minimal surface of prescribed topological structure bounded by a system of given contours (Chapter IV). Existence-theorems are established and questions such as that of the dependence of the solution on the boundary are analysed. Chapter V contains a variety of theorems on the conformal mapping of k -fold connected domains, on the basis of the methods of the two preceding chapters. In the last chapter two extensions of the theory of minimal surfaces are considered: (a) minimal surfaces of least area when the whole or part of the boundary is left free on given manifolds (minimal surfaces with free boundaries), and (b) minimal surfaces whose areas are not relative minima (unstable minimal surfaces). Many interesting problems of these two types are discussed. There are, naturally, many problems still remaining unsolved, such as those relating to uniqueness, analytic extension, branch points, etc. Such questions are explicitly formulated and discussed with reference to typical examples which suggest, in some cases, plau-

sible answers as yet unsubstantiated by complete proofs. There is a comprehensive Appendix by Prof. M. Schiffer giving an account of some recent progress in the theory of conformal mapping. The exposition attains a standard of near-perfection in the matter of charm and clarity and one has no hesitation in endorsing the author's claim that the style (of writing) "expresses adequately the balance and tension between the individuality of mathematical objects and the generality of mathematical methods". There is no doubt that this book will exercise a great influence in the further development of an important branch of Mathematical Analysis.

V. R. T.

Fundamentals of the Calculus. By Donald E. Richmond. (McGraw-Hill Book Co., Inc.), 1950. Pp. ix + 233. Price \$3.00.

What the pure mathematician means by the fundamentals of differential and integral calculus is very much different from what forms the subject-matter of this book. The publishers' blurb and the author's Preface give a clear idea of the scope and limitations of the treatment and the class of students for whom the book is written. There is a large class of students of physics, who are more interested in the march of salient ideas in physical theories than in rigorous deductions, and although they can get on, without knowing much mathematics, they find themselves helpless if they do not know an irreducible minimum of calculus, trigonometry and conics. The book under review provides that irreducible minimum.

There are seven chapters introducing the reader systematically to numbers, functions and graphs, derivatives, integration, logarithmic and exponential functions, complex numbers and trigonometry and lastly the calculus methods are used in explaining a few basic properties of the conics. There are a good many illustrative examples, followed in each chapter by exercises for the student. Answers to the exercises are given in the end. The reader for whom the book is written will find the exposition in each chapter lucid and stimulating.

All serious students who are concerned with questions of growth, form and change—whatever be their special fields of study and investigation—have to be familiar with certain elementary mathematical methods and operations. Ignorance of these is as bad as illiteracy with regard to several domains of knowledge. Books like *Fundamentals of the Calculus* play a useful part in the mathematician's campaign

against such illiteracy. The printing of the book is excellent which probably accounts for the price, which is rather high for the Indian reader.

V. V. N.

Ultrasonics. By Dr. P. Vigoureux. (Chapman and Hall, Ltd., London), 1950. Pp. vi + 163. Price 25 sh.

Ultrasonics is a subject of recent growth, a subject which could be said to have taken its birth in the stress and toils of the first World War:—it is a war baby. Though necessarily, in the beginning, much of the work in Ultrasonics was of an applied character, applied in the detection of submarines, icebergs and obstacles in general under water, nonetheless, the subject has made great advances during the last thirty years. In the early days, short reviews appearing in scientific and technical journals, were the only accounts relating to the development of the subject. The first systematic book to appear on the subject was that of Bergmann in 1937, an English translation appearing in the following year. Hiedemann's later book, published in 1939, was unfortunately not generally available outside Germany, as World War II intervened. Bergmann has already (1949—fifth edition) brought his book up to date in a completely revised and enlarged edition. In the intervening ten or twelve years, the subject has expanded so vastly that one could judge its vastness from a comparison of the two editions of Bergmann's, namely, those of 1937 and of 1949; the former lists 483 references while the latter, 2,322 references in their respective bibliographies.

Except for an English translation of Bergmann's treatise (1937), there has been no systematic attempt made to write a comprehensive book on Ultrasonics in English, till 1950. Carlin's *Ultrasonics* (1949) cannot be said to cover its fundamental aspects as it deals more with the engineering side and thereby forms a supplement to the earlier book of Bergmann.

Dr. Vigoureux, the author of a well-known treatise on *Quartz Oscillators and Their Applications*, has now set to himself the task of bringing home the subject to a larger number of persons than pure researchers and specialists in the field of Ultrasonics, by a comprehensive book on it. In the introduction to the book, the author states that the object of the book is "to introduce the reader to the technique and the simpler aspects of the theory of propagation of Ultrasonics in fluids". He has further limited

the task of keeping "the theoretical treatment as simple as possible, consistent with meeting the requirements of what explanations of phenomena are available to date". In these respects, Dr. P. Vigoureux has succeeded very well in the clarity with which he has written the book.

The book consists of topics on (1) Generation, (2) Propagation, (3) Observation, (4) Gases and (5) Liquids. Proceeding from the fundamentals of the generation of Ultrasonics, the author describes the several methods used for observation and measurement of the waves in fluids, both in respect of velocity and of absorption.

The absence of any chapter dealing with applications of Ultrasonics would indicate that this is more a book dealing with results of pure research than an account of its application in various fields.

A bibliography of some of the more recent important papers is given and the reader is referred to Bergmann's treatise for further and fuller details.

As an introduction to the subject of Ultrasonics and as a text-book for degree classes, the book is of great value and satisfies a demand on the part of students who do not require either a greater theoretical treatment or even an account of the applications of Ultrasonics in fields other than physics. The book amply fulfils the object with which it has been written.

S. P.

Ionisation Chambers and Counters. By D. H. Wilkinson. Edited by N. Feather and D. Shoenberg. (Published by the Cambridge University Press in the Cambridge Monographs on Physics), 1950. Pp. xii + 266. Price 25 sh. nett.

This book is a welcome addition to the rather scanty literature on the subject. All the fundamental processes underlying the operation of ionisation chambers and counters are still not very clearly understood and, in some cases, the point of view of different workers are different. Quite naturally, the author takes a view to which he subscribes and some may like to label such a line of approach as rather biased. But, this line of approach is inevitable in a field where our knowledge is yet not fully established. Considered in this light, the book provides a very readable and a thorough account of the subject.

The book is divided very logically into eight chapters. After an introduction on classification and devices, the phenomena of ionisation and

the behaviour of counters are dealt with. This is followed by the electrostatics of pulse formation. Then, the ionisation chamber, the proportional counter, the Geiger Counter and speed and statistics come up for treatment in separate chapters. There is a very valuable list of references at the end and an index. The book, therefore, forms a real text-book to be read by everyone who uses these devices and the references provide further material. It is inevitable that the present-day Honours student in pure physics must have a thorough grounding in this field in view of the importance of ionisation chambers and counters in nuclear physics. Hence, the book can be strongly recommended to students also. The printing and get-up of the book are excellent.

S. V. CHANDRASHEKHAR AIYA.

Input Impedance of a Slotted Cylinder Antenna.

By C. A. Holt. Engineering Experiment Station—Circular Series No. 59. (Published by the University of Illinois, Urbana, U.S.A. *University of Illinois Bulletin*, Vol. 47, No. 51), March 1950. Pp. 50. Price \$·40.

Slot cylinder antenna are at present used in the U.S.A. commercially for F.M. broadcasts and are likely to be of use for television. An analytical method for determining the input impedance of such an antenna is very desirable and useful. In the paper under review, the author attempts a solution of the problem in terms of the dimensions of the antenna and wave-length. The method is limited in application only to cases in which the ratio of diameter to wave-length is less than 0·2. The experimental results appear to agree well with the calculations. The methods of calculation are obviously approximate. In the experimental procedure, only one antenna was used and the slot length was varied by soldering short circuiting copper plugs along the slot. This procedure is not very desirable in the frequency range of 400 to 1,116 mcs/s. It may be helpful to compare the results obtained with those from separate antenna with different slot lengths. Reports of publications of this type should find a place oftener in the journals of our country.

S. V. CHANDRASEKHAR AIYA.

Structural Chemistry of Inorganic Compounds.

By Walter Hückel. Translated by L. H. Long. (Elsevier Publishing Co., Inc., New York), 1950. Pp. vii + 437. Price \$9·00.

This English translation of Prof. Hückel's original monograph *Anorganische Strukturchemie* is perhaps one of the best books on this

topic published in recent times. As the title implies, the work is not intended to be useful as a text-book of general chemistry but contains a splendid review of the fundamental theories of molecular structure as applied to both organic and inorganic compounds. The subject-matter is divided into two parts of which Book I entitled *Stoichiometry and Systematisation* deals with a few important topics, e.g., the phlogiston theory, the laws of chemical combination and the concept of chemical affinity (Chapter 1). The next chapter presents in some detail the general classification of inorganic compounds as based on the periodic law, modern views on valency, the co-ordination theory and different bond types in simple and complex molecules. The author has assembled information on the state of bonding in compounds of higher order and a number of controversial topics regarding the application of Werner's theory to such compounds are discussed to emphasize the necessity of structural thinking in inorganic chemistry. This is followed by an exhaustive and critical review on the co-ordination theory of complex compounds. The data are arranged systematically and classified in two parts. Part I is devoted to the structure of mononuclear complexes. Spatial structures of such molecules with different co-ordination numbers are discussed along with an instructive review on the inner complexes and polymeric co-ordination compounds.

In Part II a critical evaluation of the data regarding polynuclear complexes is given. This includes the hetero- and polyacids, the metaphosphates and the silicates. The method of assembling the data, its system of classification, the points of emphasis and text contexts—while resembling each other in some respects, are also distinctly different from the existing literature.

Book II, *Atomic Structure and Chemical Bonding*, deals with the comparative examination of atomic structure from the point of view of the periodic classification, and elaborates on the discussion of various physical theories concerned in the study of the extra-nuclear structure of the atom. This is followed by detailed information about the experimental methods adopted in the investigation of chemical bonding. Simple bonds between like and unlike atoms, multiple bonds and the phenomena of isosterism and mesomerism as applied to (electronically) similar compounds predominate among the types of structures discussed in the last chapter, along with the translator's note embodying a critical discussion on Pauling's theory of resonance in inorganic compounds,

It would be difficult to find a more adequate and useful assemblage of information about the subject than is present in these 437 pages. It is an original and erudite study of chemistry from quite a new angle.

According to the author, the work is intended to make it clear that a study of inorganic chemistry in conjunction with organic chemistry provides a magnificent and internally consistent over-all picture of the structure and constitution of matter. The book lives up excellently to this description and should serve well to stimulate the interest of students and teachers of chemistry in the subject.

G. S. DESHMUKH.

An Introduction to the Embryology of Angiosperms. By P. Maheshwari. (Publishers: McGraw-Hill Book Co., Inc., New York, U.S.A.), 1950. Pp. x + 450. Price \$6.00.

Since the publication of Coulter and Chamberlain's compendium dealing with the embryology of angiosperms in 1903, the subject has progressed and ramified prodigiously both in academic and in applied aspects. Within the last 50 years, plant embryology has become almost an independent science. All countries with any record of scientific achievement have contributed to this rise in its status; and the literature of such contributions has appeared in all the major languages of the world. As a consequence, we have now an unmanageably large output of information which called for organization, integration, and critical evaluation. It is gratifying that so distinguished a worker in the field as Prof. Maheshwari has come forward to render this service.

After giving a comprehensive resumé of the origins and development of the science of plant embryology from the time of Amici to that of Schnarf, Prof. Maheshwari has devoted seven chapters to the elucidation of the development of the male and female gametes from the moment of their inception right through fertilization, endosperm formation, and embryo development. The next two chapters deal with the phenomena often accompanying the production embryos,—apomixis and polyembryony. Applied aspects of plant embryology are treated in two chapters: its relation to taxonomy and its experimental prospects. In the final chapter, we learn about the contribution of embryology towards an understanding of the phylogeny of angiosperms. At the end of every chapter is given a selected and up-to-date bibliography.

Prof. Maheshwari's style of presentation is engagingly lucid and bright, and authoritatively

accurate. He has avoided digressions and controversy so as to make the book acceptable to the general botanist not interested in special details. To the college student, the book should prove an invaluable companion. To the teacher, it is the only source of cumulative information. To the research worker, the book, in addition to directing him towards problems yet to be investigated and providing him with essential preliminary information, provides stimulus for thought and discussion and gives impetus for further work. The publication of such a comprehensive work on this important subject by a distinguished Indian scientist is an event for every Indian to be proud of. The get-up of the book is excellent as usual.

B. G. L. S.

Functional Anatomy of the Vertebrates. By Daniel P. Quiring. (McGraw-Hill Book Co., Inc., New York, Toronto, London), 1950. Pp. xi + 624. Price \$5.50.

For generations, zoologists had been teaching the comparative anatomy of dead animals without worrying about how these animals lived. But, since the First World War, an outstanding change has come about which has transformed zoology largely from a descriptive to an experimental science. It has now become recognized that animal structures should be taught not merely in the way in which they are built, but also at the same time, in the way in which they function. This book is a welcome attempt at treating comparative anatomy from a dynamic rather than from the old static viewpoint, and in uniting description and fact in such a manner "as to build a series of conclusions that explain details and introduce us to function". Within the limits the author has set himself, the book is well planned and deals with the structure and function of all the organ-systems. There are interesting sidelights on some of the systems based on the author's field work, and a useful appendix giving weights of the body and different organs of 3,581 vertebrate animals.

K. N. B.

Tissue Culture Technique. By Gladys Cameron. (Academic Press, New York), 1950. Pp. 190 with 75 illustrations. Price \$4.20.

Tissue Culture, like bacteriology, has its own special technique. The early masters, like A. Fischer, dealt with both the theoretical and practical aspects of tissue culture. But with greater advance, tissue culture has developed a technical literature of its own. Hitherto, the best book on the subject was Rhoda Erdimann's *Praktikum der Gewebeflege* which, not only

gives details of laboratory operations but also refers to many theoretical details.

The book under review is also written by a lady and has undergone two editions which, in itself, speaks of its value. The material is well organised, clearly presented and pruned of all superfluous details. Emphasis has been laid throughout on the practical side, e.g., Appendix C gives the list of materials required for tissue culture with addresses of firms supplying them. Chapter XVII describes in 8 pages the histological technique indicating only what pertains to tissue culture. The chapter on Photomicrography has been contributed by Grand, a specialist in this field. Phase contrast microscopy has been briefly but clearly described. Prof. Chambers, as a master on the subject, offers an illuminating chapter on his own minomanipulator coupled with a special inverted microscope. The book is printed on art paper and is well bound, so that the price, 4 dollars, seems most reasonable.

To all interested in tissue culture, Miss Cameron's book is most indispensable.

S. MAHDIHASSAN.

Indian Concrete Journal: Special Number.
International Engineering Conferences.

At present only 6 per cent. of the entire water available in the country is being used for productive purposes. There are nearly 134 million acres of land suitable for cultivation. Plenty of man-power is available in the country to cultivate these lands provided the water which is now running to the sea is made available to the land during the long breaks occurring between successive rainfalls. The huge reservoir projects planned for this purpose have been described in great detail in this Journal. River valley projects really mean steel and concrete. The part concrete has to play in the execution of many schemes has been well brought out by the articles in the Journal.

The editorial staff deserve to be congratulated on the timely issue of this Special Number during the International Engineering Conferences.

The usual high standard of the Journal has been kept up.

N. S. G.

The Pasteur Institute of Southern India, Coonoor. Annual Report of the Director for 1949-50. (Diocesan Press, Madras), 1951. Pp. 1-66.

The Report deals with (1) routine activities, and (2) research.

Salient features of (1) are: (a) Production and distribution of A.R.V. and treatment of cases that visit the Institute; (b) Examination of pathological materials for clinical diagnosis.

Research activities included the following:

(a) Superiority of Semple's 5% vaccine to 1% vaccine, which was used during 1912-24, was shown by analysis of mortality rate of the treated cases from both groups; (b) Phenol-killed liquid cultures of *V. cholera* vaccine of both sub-types, Intaba and Ogaura, were found not inferior to agar culture vaccine of the same; (c) Receptor Destroying Enzyme (RDE) of both sub-types of *V. cholera* isolated from strains from same epidemic and in diffe-

rent epidemics obtained from Madras and Bengal showed variations when tested by hæmagglutination titration; (d) Effect of BAL on cobra venom *in vitro* and *in vivo*; (e) Significance of fusospirochaetes in gastro-intestinal tract and associated clinical syndrome and response to arsenical or penicillin therapy; (f) Field and laboratory investigation of an outbreak of influenza in Nilgiri District and Madras City in 1950; (g) Continuation of animal experiments with pathological materials from cases of Tropical Eosinophilia indicating definite lesions in the lungs of guineapigs.

K. P. MENON.

SCIENCE NOTES AND NEWS

Tata Institute of Fundamental Research Bombay

The new session of the Institute begins on the 1st July, 1951. Admissions will be made for advanced study and research in Mathematics and Physics. A number of research Studentships of the value of Rs. 175 per month are available for research in (1) Modern Algebra, (2) Function Theory and Fourier Analysis, (3) Differential Geometry, (4) Statistics, (5) Quantum Mechanics, (6) Cosmic Radiation and (7) Nuclear Physics. Research students may register for the Ph.D. of the University of Bombay or of any other Indian University. Hostel facilities are available.

Persons holding an Honours degree in Physics or Mathematics or possessing equivalent qualifications are eligible for admission.

Applications for admission on the prescribed form (obtainable gratis on request) together with a fee of Rs. 2 should be sent to the Registrar so as to reach him on or before the 15th June 1951.

Scholarships for Engineering Apprentices

Engineering graduates from Commonwealth countries, including India, will be eligible to take part in a scholarship scheme which provides a thorough engineering training at factories of the Brush-Associated British Oil Engines Group of Companies (Brush-ABOE), Britain's largest manufacturers of Diesel engines and world-wide suppliers of electrical equipment. It will allow for two years' study

of the products and methods of production of the Group and will provide technical experience of considerable value.

A free return passage from the apprentice's home to Britain will be provided together with additional travelling expenses. The apprentices from the Commonwealth countries will receive the same wages as those paid to other graduate apprentices at present working at the Group's factories.

Steps are being taken to bring this offer to the notice of the appropriate authorities in South and South-East Asia through the Council for Technical Co-operation, which had been set up under the Colombo Plan.

Research Degree Awards

Shri. Onkar Nath Mehrotra, M.Sc., has been awarded the Ph.D. Degree of the Banaras Hindu University for his work on "Physiological Basis of Drought Resistance in Sugarcane". The thesis was evaluated by Profs. Bernard S. Meyer and Charles E. Olmsted, U.S.A., and Dr. K. N. Lal, of the Banaras Hindu University.

Sri. K. Subramanyam, M.Sc., has been admitted to the Doctor of Science Degree of the University of Mysore, for his thesis on "Embryological Studies in Certain Families of Campanulatae and the Melastomaceae".

New Library Services for India

A public library of a new kind—especially designed to meet the needs of readers using books for the first time in their adult lives—

is to be opened shortly in Delhi. The institution is the result of an agreement between the Government of India and the UNESCO, providing for a pilot project to show how public library services can effectively support literacy and adult education campaigns.

Postwar Scientific Bibliography for Indonesia

A Medical Bibliography for the period 15th August 1945 to 31st December 1950, has been issued as O.S.R. Bulletin 9, from Indonesia.

Coloured Diamonds from Cyclotron

Red, green and black diamonds are coming out of Birmingham University's 300-ton cyclotron, which is altering the colour of ordinary diamonds in this way for the first time in Britain.

Changing the colour of diamonds in the cyclotron takes only a few minutes. Prior to this, red, green and blue diamonds were obtained for research from the British Atomic Energy Research Establishment at Harwell, where the coloured diamonds were produced more slowly in the atomic pile.

—By courtesy to the B.I.S.

Coal Tar Creosotes of Indian Origin

Toxicity tests carried out with *Polystictus sanguineus* in the Forest Research Institute, Dehra Dun, indicate that the high boiling fractions of creosote are more toxic than the lower boiling ones and that it is not necessary to specify any limits for acid content in creosote specifications. Accelerated field tests also indicate that heavier creosotes and creosote fractions are more toxic and more permanent. Further, the results of accelerated service tests indicate that if 75 : 25 or 50 : 50 mixtures of creosote-fuel oil are used, considerable latitude is possible in creosote specifications. This confirms the soundness of the practice of using creosote-fuel oil mixtures in this country.

Entomological Society of India

The following Office-bearers were duly elected for 1951-52: *President*: Dr. E. S. Narayanan, New Delhi. *Vice-Presidents (from ex-Presidents)*: Dr. H. S. Pruthi, New Delhi; Dr. K. B. Lal, Kanpur. *Vice-Presidents (New)*: Dr. I. M. Puri, Delhi; Dr. K. N. Trehan,

Ludhiana. *Councillors*: Shri. S. Ramachandran, Coimbatore; Dr. V. P. Rao, New Delhi. *Chief Editor*: Shri. Y. Ramchandra Rao, Bangalore. *General Secretary*: Dr. S. Pradhan, New Delhi. *Joint Secretary and Treasurer*: Shri. S. N. Chatterjee, New Delhi.

The Royal Institute of Chemistry of Great Britain and Ireland: N.I. Section

At the Annual General Meeting of the Northern Indian Section of the Royal Institute of Chemistry, held on 3rd March 1951, the following Office-bearers were elected:—

President: Prof. T. R. Seshadri; *Hony. Secretary*: Dr. G. S. Saharia.

Prof. C. Mahadevan

The Syndicate of the Andhra University has awarded Prof. C. Mahadevan, Head of the Geology Department of the Andhra University, the Travancore-Hyderabad Travelling Fellowship to study recent advances in U.S.A. in pure and applied Geology. The U.S. Government have given Prof. Mahadevan the Fulbright Travel Grant and the Committee on International Exchange of Persons have invited him as a visiting scholar in the exchange visitor program.

Scientific Expeditions to Australia

The High Commissioner for Australia in India has advised that whenever any scientific expedition, whether Governmentally or privately sponsored, intends to visit Australia, prior intimation to this effect may please be given to him. This would enable the High Commission to inform the Australian Commonwealth Scientific and Industrial Research Organisation, who will, if required, be glad to make arrangements for its officers to assist the expedition to the fullest extent.

ERRATUM

Vol. 19, No. 10, October 1950, p. 311, in the Paper "Electro-Deposition of Metals and Alloys from Cyanide-Free Baths, Part II: Copper from Ethanolamine Solutions":

Column 2, line 1:

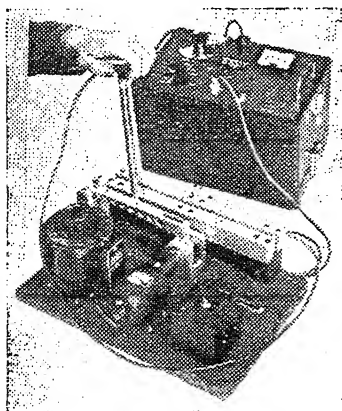
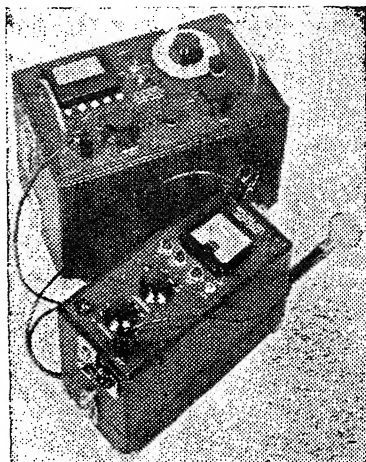
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MORE ABOUT THE IRIDESCENT FELDSPARS*

SIR C. V. RAMAN

BY reason of the brilliance and variety of the colours which it displays and of its availability in fairly large sizes, labradorite is easily the most spectacular amongst the iridescent feldspars. The explanation of the effects which it exhibits had also long remained rather mysterious. For these reasons, it was the first to be taken up for investigation. The ideas and methods of study which enabled the problem of its behaviour to be satisfactorily solved had evidently a wider field of application, and the next case which was accordingly taken up was that of the Ceylon moonstones, a fairly large collection of which was available for study. The optical effects which these display range in character from a soft blue or bluish-white shimmer to a brilliant white glitter, this being most prominent when the specimen is held in a particular orientation with respect to the direction of incidence of light on it and the direction of observation. The "Schiller" of the Ceylon moonstones—as this optical effect is called—was believed by mineralogists to be due to a

lamellar structure of the material. Many of the earlier writers, *e.g.*, Boggild, were of the opinion that such structure lay beyond the power of the microscope to resolve. On the other hand, Dr. E. Spencer claimed that under certain favourable conditions of illumination, the structure responsible for the schiller could be observed under the microscope and even photographed. The assumption implicit in either explanation of the schiller effect is that it is in the nature of a geometric reflection of the light traversing the material by the layers of heterogeneity. The Bangalore investigations, however, showed that this assumption does not correspond with reality. The observations with the moonstones exhibiting a blue schiller proved that the optical effect actually shown by them is a diffusion of light over a very wide range of angles. The bluish-white or white schiller exhibited by other specimens is also essentially a diffusion of light, though the angular range over which its intensity is notable is considerably less than in the case of a blue schiller. From the distribution of intensity of the diffused radiation over the entire solid angle, it is possible to infer the nature of the structure giving rise to it. It is found that in all cases, the details of the structure responsible for the schiller

* An earlier article on the Iridescent Feldspars appeared in *Current Science* for October, 1950, **19**, 301-05 see also, *Proc. Ind. Acad. Sci.*, 1950, **32A**, 1-16 and 123-40.

are well beyond the power of a microscope to resolve even in the most favourable circumstances. Indeed, one may say that, *macroscopically considered*, the Ceylon moonstones, like labradorite, are essentially monocrystals, and that the diffusion of light which they exhibit is a consequence of local fluctuations of composition and refractive index. The analogy with the well-known optical behaviour of liquid mixtures of which the components are only partially soluble in each other naturally suggests itself in this connection.

The account of the subject given in an earlier article in *Current Science* was deliberately made brief, as it was intended to follow it up by a fuller account when our investigations had progressed further. Much new material has meanwhile come into our hands. Besides the specimens of uncut moonstones from Ceylon presented by Mr. Punnyasoma, we have now some fifty-eight cut and polished specimens of

also enabled me to visit the pegmatite areas in the Coimbatore District in South India, and bring back with me a collection of specimens of orthoclase feldspar exhibiting a golden-yellow schiller. When all this material has been properly studied, there should be quite a good story to tell.

In our earlier studies on the behaviour of labradorite and of the Ceylon moonstones, the technique adopted was that of illuminating the entire specimen with a beam of light and of observing or photographing its whole area from different view-points. We have since found that for many purposes, it is advantageous to adopt a somewhat different technique, in which a *small area* of the specimen is illuminated by a narrow intense beam of light and the radiation diffused by it is received on a white screen held at not too great a distance. The distribution of intensity of the light diffused in various directions can then be simultaneously

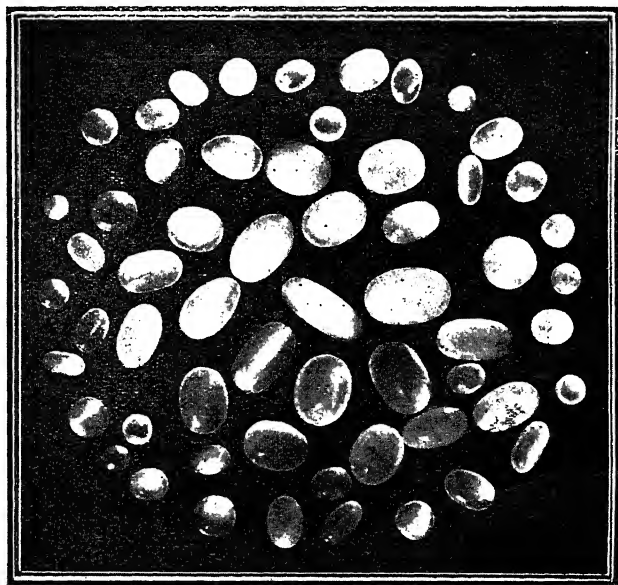


FIG. 1

A Collection of Ceylon Moonstones

the same material, the optical behaviour of which is a fascinating study (Fig. 1). Prof. Ito of the Mineralogical Institute of Tokyo has very kindly sent us a collection of small but beautifully crystallised moonstones from Korea. Through the kindness of Prof. T. N. Muthuswamy of Madras, we have received a collection of quite large pieces of plagioclase feldspar from Gudur in South India which show a blue or bluish-white iridescence. Some kind friends

observed. By traversing the specimen across the incident pencil of light, or by altering the tilt of the specimen with respect to its direction, one can quickly study the changes in the pattern of diffused light resulting therefrom. The observations should preferably be made in a dark room. The more intense the incident pencil of light is, the more striking are the effects observed. It is necessary, of course, to eliminate effects arising from refraction or scattering at

the external surface of the specimen. This may be done by immersing the specimen—if it be not too large—inside a glass cell containing a transparent liquid of suitable refractive index

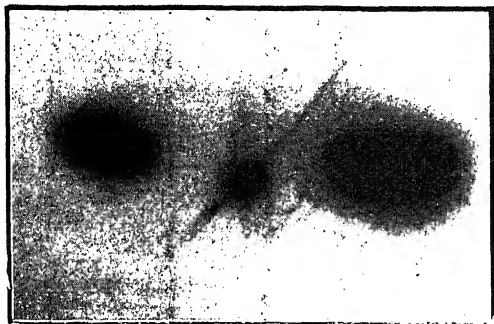


FIG. 2

The Diffusion Pattern of Labradorite and traversed by the incident pencil of light. With large specimens, on the other hand, if the external surface is polished, no such immersion is necessary. But if the surface be rough, the scattering may be eliminated by spreading a little Canada balsam and covering it with a strip of glass. The diffusion pattern may be conveniently photographed by receiving it directly on a piece of bromide paper.

while the two elliptic patches, one on either side, represent the characteristic iridescence of the labradorite. These two patches have their origins respectively in the alternate layers of the albite twinning which is very common in the plagioclase feldspars.

With the Ceylon moonstones, we invariably observe only one elliptic patch of diffused radiation. This has a very large area in the case of the specimens exhibiting a blue schiller, a smaller area in the case of those showing a bluish-white schiller and the smallest area with the moonstones giving a white schiller (Fig. 3). From the dimensions of these patches of diffused light, it is possible to determine the linear extension in the different directions of the heterogeneities of structure responsible for the observed effects. We may mention that we have also used the same method of observation for the study of other species of iridescent feldspar. For instance, the Korean moonstones show usually only one, but sometimes two, and occasionally four separate diffusion patches, arranged with tetrahedral symmetry about a common direction. There is visible evidence that the crystals in these latter cases are not simple but twinned. Finally, one should make mention of the fact that the method of obser-

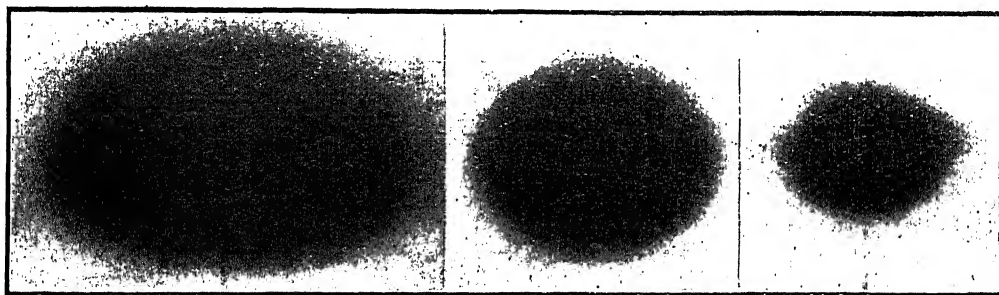


FIG. 3

Diffusion Patterns of the Ceylon Moonstones

(a) Blue Schiller, (b) Bluish-White Schiller (c) White Schiller

As a method of demonstrating the origin and characters of the iridescence, and exhibiting the relations between the phenomenon and the crystal orientation, and the influence of the disposition of the twinning layers (if any) present in the specimen, the technique described above is extremely convenient. This remark is illustrated by Fig. 2 which shows the diffusion pattern of one of our specimens of labradorite. The central black spot in the picture is the record of the "aventurine reflection" due to the Fe_2O_3 crystals included in the labradorite,

while the two elliptic patches, one on either side, represent the characteristic iridescence of the labradorite. These two patches have their origins respectively in the alternate layers of the albite twinning which is very common in the plagioclase feldspars. While the two elliptic patches, one on either side, represent the characteristic iridescence of the labradorite. These two patches have their origins respectively in the alternate layers of the albite twinning which is very common in the plagioclase feldspars.

In the development of the new method of observation here described, my collaborators, Messrs. A. Jayaraman and T. K. Srinivasan, have played a notable part.

LOCUSTS AND GRASSHOPPERS

HEM SINGH PRUTHI

(Director, Locust Control and Plant Protection Adviser to the Govt. of India, New Delhi)

FROM the report published in *Nature*, Vol. 166, No. 4224, October 1950, of the symposium on Locusts and Grasshoppers, held at the recent meeting of the British Association (Zoology Section) at Birmingham, it appears that Dr. Uvarov, Director, Anti-Locust Research, London, who opened the discussion, and other speakers kept mainly Africa in view in their appraisal of anti-locust work. The Desert Locust, which admittedly has outbreak areas extending over about 25 countries in Africa, Ariabia and south-west Asia, is the most important locust in India. Considerable work has been carried out on this locust on the Indian sub-continent during the past 20 years or so, and very appreciable progress has been made both in technical and organizational work for its control. Moreover, international collaboration between various countries in south-west Asia has reached a fairly high level. Therefore, a brief account of the work carried out in this region during the past 25 years is likely to interest those interested in locust problem. Moreover, a symposium on an international pest like the locust will be inconclusive if a very important region of its activity is ignored.

During the 1926-31 cycle, the Government of India (then undivided) established a Locust Bureau for the proper supervision and co-ordination of anti-locust work in the country. On account of rush of control work during the cycle, adequate attention could not be paid to research work; but in 1931, when the cycle declined, the Indian Council of Agricultural Research set up an organisation (under Mian Afzal Hussain) for work on the biology and ecology of the Desert Locust. The work was divided into two units, one for laboratory research with headquarters at Lyallpur and the other for research in the field with headquarters first at Quetta and subsequently at Karachi (with Y. Ramachandra Rao in charge). These research units carried out for about ten years several detailed investigations and collected very important and valuable information, the results of which have been published in several periodicals in the U.K. and in India. All the suspected outbreak areas were properly mapped, seasonal fluctuations in locust population in different regions of the country were recorded and it was shown for the first time that migra-

tions of locusts of the solitary phase were similar to those of swarms. Conditions under which locusts acquire gregarious characters in large field cages and laboratory were studied. Many other problems discussed at Birmingham were also posed and investigated.

In 1939, the Government of India established a Locust Warning Organization on a permanent basis. Its functions included further study of locust ecology in the outbreak areas and of changes in locust population and phases under different conditions, control of incipient swarming, forecasting of developments in locust activity, etc.

In the summer of 1940, a fresh locust cycle started in India as in other countries in the locust belt. A control wing was added to the Locust Warning Organization for organising control operations in all the desert breeding areas of the country irrespective of state or provincial boundaries. Under a Co-ordinated Anti-Locust Scheme, all the crop areas which were to derive benefit from the campaign against the locust in its desert homes willingly agreed to share the expenditure incurred in the desert breeding areas. The Head of the Central Organization (the writer) was responsible for an overall supervision of the control work in the target areas also and he kept himself fully acquainted with the work of similar organizations in the neighbouring countries. The result of work thus co-ordinated was that for the first time in history, control operations were so successful that crops worth crores of rupees escaped from any appreciable damage throughout the World War II, when food supply was really very difficult. From a technical viewpoint, though India was invaded by swarms coming from Western countries every summer, it is noteworthy that even during the peak years of 1943-46 extremely few swarms indeed went in the opposite direction in the autumn. It may be pointed out in this connection that the number of swarms which come into India from the western direction during the summer depends on the adequacy of control measures in Baluchistan and the Middle East countries, and perhaps beyond, where locust breeding takes place during spring in the wake of winter rainfall. Similarly if work in the summer breeding areas of India (and Pakistan) is not successful, swarms develop, some of which fly

towards the west in the autumn, while others penetrate into the interior of the country and may reach Bengal and Assam in the east, and Madras in the south. The success of the work carried out in India was fully appreciated at several international conferences, e.g., Tehran, Cairo, Karachi, etc. Of the Karachi Conference (November, 1943), when representatives from the U.K., USSR and some Middle East countries were also present, the main object was to assess the extent of swarm migrations which might be expected from India to the Middle East countries during that season. It was concluded that chiefly on account of the adequate work carried out in India during the past summer, the migration, if it materialised at all, would be on extremely small scale. Actually no swarm crossed into Iran and Arabia during the season. In view of this, one is justified in considering that the anti-locust campaigns carried out in India during World War II were perhaps more successful than those in Africa and the Middle East—the only countries mentioned at the symposium at Birmingham.

As regards international collaboration, India was the first country to send a locust mission to Iran in the spring of 1942. In 1943 and subsequent years of the cycle, Indian parties worked not only in Persian Mekran but in eastern Arabia also. Fortnightly, monthly and annual reports on locust work carried out in India and by the Indian missions in the adjoining countries were sent regularly to all the countries interested in locust control and to the Anti-Locust Research Centre, London, which was kept informed of major developments even by cables.

With the establishment of Pakistan in 1947, the Indian Locust Warning Organisation was divided on regional basis but the two organisations are working on the sub-continent in collaboration. As a matter of fact, an Anti-Locust Convention has been in force since August 1947 for international collaboration between India, Pakistan and Iran. Representatives of the three countries meet frequently for exchange of information and experiences, and formal conferences are held annually in different countries by turn. With the outbreak of another cycle during 1949, the three countries have jointly assisted in the control operations in Oman and Trucial coast of Eastern Arabia. Technical experts of other governments interested in the desert

locust are also invited to the annual conferences. For example, about a dozen nations including the U.K., France, USSR, Egypt, various Middle East Countries, Afghanistan, etc., were invited to the International Anti-Locust Conference held in New Delhi in November last. The F.A.O. also sent their expert. Some of these countries attended a conference of this kind for the first time and it is gratifying that the level of international co-operation was raised still higher.

While directly connected with the anti-locust work in India, the writer has been in close touch also with the locust situation in other countries during the past 16 years. Reviewing the position in the desert locust belt as a whole, it appears that considerable progress is necessary in the most essential work of mapping the outbreak areas on the African and Arabian continents. In the vast majority of countries permanent national organizations have to be set up, which alone can do such work adequately and economically. On the African continent, this should not be so difficult because many of the countries are under the control of enlightened Western powers such as U.K., France, Spain, Italy, etc. The work in Egypt and the Anglo-Egyptian Sudan is already of a high order. The Desert Locust Survey which was established in 1948 by the U.K. with headquarters in Nairobi, of which the functions are similar to the Indian Locust Warning Organisation set up in 1939, has made extensive surveys in the east African countries and in the neighbouring parts of Arabia. As is the practice during outbreak periods in India since 1942, a control wing called Desert Locust Control has also been recently set up for organising control campaign in the countries in the charge of U.K. Organisation. It is hoped that during this cycle, which is very serious, other countries will also establish similar organizations and it will be possible to raise the standard of international collaboration on the African and the Arabian Continents, which will go a long way in the establishment of overall co-operation between all the countries affected by the locust and in the further elucidation and solution of locust problem. In science, as in other spheres of human activity, international co-operation must be based on international understanding and appreciation of one another's contributions towards the common objective.

THE EFFECT OF HYDROGEN ON STEEL AND FORMATION OF HAIR-LINE CRACKS

A. B. CHATTERJEA AND DR. B. R. NIJHAWAN

(National Metallurgical Laboratory, Jamshedpur)

ALL available evidence indicates that hydrogen is essential for the formation of hair-line cracks. Thus, Cramer and Bast¹ treated steel with hydrogen and found that this element played an important part in the development of flakes. Musatti and Reggiori^{2,3} found no segregation of nickel or chromium at the flakes by chemical and microscopic studies. Andrew and co-workers⁴ and Cramer⁵ produced hair cracks after heating the specimens to 1200 deg. C. soaking in hydrogen, quenching in water, and ageing at room temperature for at least 24 hours. This incubation period was previously noticed by Klausting.⁶ The cracks developed spontaneously after the incubation period. Specimens soaked in nitrogen did not develop these cracks. Andrew, *et al.*⁷ found that alloying elements have little, if any, effect upon the diffusion of hydrogen in steel. The evolution of hydrogen was maximum at the end of the thermal transformation. Presence of hydrogen not only leads to formation of cracks but also affects mechanical properties. There is an embrittling effect for hydrogen content from 1-3 c.c./100 g. Cracks appear even in the absence of transformation stresses. Although no cases were observed of internal crack formation in the absence of hydrogen, certain specimens showed no cracks in spite of high hydrogen content. This is confirmed by Sykes, Burton and Gegg.⁸ They found that a softening treatment renders the material immune to crack formation when air cooled from the austenitic condition. They demonstrated that transformation stresses, quenching stresses and the presence of hydrogen are additive in producing cracks, and that hydrogen rich materials are more susceptible. But it is found that slow cooling helps in preventing the development of flakes.^{1,3,9,10,11} Houdremont and Korschan¹² showed that the rate of cooling through the range of about 200 deg. C. is important, since gaseous hydrogen separates from solid solution then. Andrew, *et al.*¹³ noticed an increase in rate of hydrogen evolution at the γ - α transformation and elements which lower this change in steel were found to retard the evolution of hydrogen. The hardness and microstructures of nitrogen and hydrogen-soaked specimens

were, however, found to be identical. These observations suggest that attention must be paid to the following factors²⁵ to eliminate hair-line cracks: (a) H_2 content of liquid steel; (b) segregation in the ingot; (c) refining of the structure by heat-treatment; and (d) removal of transformation stresses.

Methods for determining hydrogen in steel have been developed by Iwase and Fukushima,¹⁴ Hare, Peterson and Soler¹⁵ and described in a Symposium published in the *Trans. AIME* (1945, 162, 353).

A few earlier authors have also attributed other causes for the formation of hair cracks, e.g., the difference in concentration of carbon and chromium in chromium steels¹⁶ and crystal segregation.^{11,17} Schall¹⁸ believed that shatter cracks formed after the last reversal in internal stress during cooling nearly at room temperature.

Regarding the mechanism of the crack formation, Honda and Hirone¹⁹ showed that the pressure exerted by the evolution of hydrogen, combined with thermal and transformation stresses, suffice to form the flakes. Guichard, Clausmann and Billon²⁰ reported that hydrogen formed water vapour with oxides instead, thus developing enough pressure to form flakes. According to Zaffe and Sims,²¹ who assume a 'block' structure, hydrogen remains occluded in interblock disjunctions under pressure, and when this pressure exceeds the elastic strength of steel, cracks are formed. Andrew, *et al.*¹³ suppose these disjunctions to be misfits in the lattice, which could accommodate one molecule of hydrogen which is sufficient for the purpose. On this basis, Andrew and Lee²² suggested that the variation of the size of mosaic blocks may account for the different response of steels of different compositions and treatments to hair-line crack formation. The disruptive pressure of methane formed from carbide by atomic hydrogen¹³ is also another possibility.

Based on experimental results, Zapffe^{23,24,25,26} put forward a strong evidence in favour of "Planar-pressure theory". According to this concept, hydrogen embrittlement is nothing other than the result of an ageing action in which the precipitate is a gas and is inconsis-

tent with concepts based on lattice distortion or compound formation.

It is thus observed that slow cooling appears to be beneficial in preventing hair-line crack formation, the fundamental cause of which is presence of hydrogen in steel. But no wholly acceptable theory has been put forward to account for the phenomenon.

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RECENT PROGRESS AT THE INDIAN INSTITUTE OF SCIENCE, BANGALORE

IN the course of his Welcome Address to President Rajendra Prasad, and the First Visitor of the Institute under the new Constitution, Prof. Thacker, Director, reviewed the recent progress of the Institute and outlined its future development. He said: "The spirit of research wedded to the cause of raising the economic and social standard of our country has been the ideal which has all along been followed by our workers in their endeavour and, I hope, that this spirit which has been imparted to this Institute by its Founder will be pursued in the future also in an ever-increasing measure.

Till 1940, there were only the Departments of Physics, Chemistry and Electrical Technology in this Institute. In 1941 with the help of funds made available by the Government of India, the Department of Aeronautical Engineering was started in recognition of the part that aviation would play both in times of war as the backbone of a country's defence and in times of peace as a speedy mode of communication. Shortly thereafter a deputation led by our President of the Court and Chairman of the Council, Sir Vithal N. Chandavarkar, waited upon the Government of India with a four-year programme of development of the activities of this Institute. The scheme which gained ready support was in-

augurated in 1946. Under this have been established the Departments of Metallurgy, Internal Combustion Engineering and Electrical Communication Engineering, which are now doing good work. The activities of the older Departments have been expanded and laboratories for research in Food and Fermentation Technology and Pharmacology added to the Department of Biochemistry. Provision was also made for background training in Economics and Social Sciences to young technologists, and for the deputation of selected members of the staff to the U.K., the U.S.A., and Europe for getting acquainted with the latest advances in their particular spheres of work.

At its annual meeting held in 1945, the Court again laid emphasis on the need for the provision of facilities for post-graduate study and research in Heavy Engineering, Power Engineering and the Designing of Machinery in view of the post-war plans for the proper development of the resources of the country. A Committee of Experts drew up a Scheme for the establishment of a Department of Power Engineering which was approved by the Government of India and work for the starting of the Department was commenced towards the end of 1947, the entire cost of this Scheme being met by the Government of India.

The object of this Department* is to provide instruction to engineering graduates of Indian Universities in Power Engineering (Hydro-electrical and thermal) for a period of two years, including a period of specialised practical work outside, so that when they emerge from this course they should be able to take up immediately and discharge with confidence superior responsibilities.

In view of the very little scope for research in engineering and very little engineering research being done in India at present, research would also be given due importance and receive prominence as the Department progresses.

Also, it was resolved by the Standing Advisory Committee to request the Government

* The Power Engineering and High Voltage Engineering Laboratories of the Institute were declared open by the President on this occasion.

that a grant which may be earmarked for a Hydraulic Machines Laboratory Wing in the Ministry of Natural Resources and Scientific Research be diverted to this Department, as such diversion resulting in a co-ordination of effort would be in the best interests of the country.

Mutual co-operation and friendly collaboration between scientific institutions and industrial establishments are of extreme value both to science and industry. This Institute has all along been playing its part in establishing such a liaison with industry; and its main objective has been the fostering of investigations especially in those branches of science as would assist industries by providing them with the results of research which they need. In the Western countries, applied research is a charge on the industries which it serves; and it is time that in India too the industries recognise the need to support technological and research institutions."

ORIGIN AND DISTRIBUTION OF CULTIVATED PLANTS IN SOUTH ASIA

A SYMPOSIUM on the above subject was held in Delhi from 12-15 January 1951, by the Indian Society of Genetics and Plant Breeding with the co-operation and assistance of the UNESCO South Asia Science Co-operation Office. The purpose was to review the work done so far on the taxonomy and cytogenetics of crop plants, with a view to stimulate further study. Professors S. C. Harland (Manchester), Edgar Anderson (Washington), and A. Muntzing (Lund), were present by invitation. Delegates from Academia Sinica, Peking, workers from Ceylon, Singapore and Pakistan also attended. There were also observers from various other scientific bodies and institutions.

Mr. K. Ramiah, Director, Central Rice Research Institute, Cuttack, was elected Chairman; and discussion on the following subjects took place.

12th January: Rice, wheat, banana and mango; 13th January: Citrus, sugarcane, millets, brinjal and orchids; 15th January: Cotton jute, sesame, spices, palms. Each day, the session

began with an introductory talk by one of the expert consultants, who dealt with general and theoretical aspects of the subject, and expounded particular lines of work which had proved to be of practical value. The papers on each crop was followed by a discussion.

The complete proceedings are to be published soon by the Indian Society of Genetics and Plant Breeding, copies of which may be had from the Secretary of the Society, Indian Agricultural Research Institute, New Delhi.

Besides the much needed review of cytogenetics of economic plants, the symposium brought out some important points which would be of value for any long-range programme for improvement of crop plants, such as: (1) organising a Bureau of Plant Introduction, (2) setting up a Committee for Plant Exploration in Indo-Malayan region, and (3) intensifying study of plant taxonomy and cytogenetics in botanical research centres.

C. G.

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A HISTORICAL NOTE ON A THEOREM IN INCOMPLETE BLOCK DESIGNS

A THEOREM in incomplete block designs first glimpsed by the author partially in 1946¹ has been completed by Schützenberger in 1949² and his proof has been improved upon by Chakrabarthi in 1950.³ The aim of this note is to put these results in their historical perspective and also to indicate a method of proving them without vector notions, but using the matrix representation of a block design mentioned by the author in 1943.⁴

The symbols v , b , r , k in this note will be used in the sense of Fisher and Yates in connection with balanced incomplete block designs. $d = (r - \lambda)$ where λ is the number of elements common to any two sets in a block.

The theorem proved in 1946¹ is: "A necessary condition for a cyclic solution to exist is that $(r - \lambda)$ should be a perfect square when v is even. Hence a difference set cannot exist when v is even and $r - \lambda$ is not a perfect

square, e.g., $v = b = 46$, $r = k = 10$, $\lambda = 2$." This is quoted by Bose⁵ who adds that for the above design which is yet unsolved, at least no cyclic solution can exist.

Schützenberger has completed the theorem and shown that if v is even, a symmetrical design can exist only if $r - \lambda$ is a perfect square. But his proof involves complicated methods. The shorter proof of Chakrabarthi also includes orthogonal vectors and Laplacian expansion for determinants.

The result can be proved with the help of the author's matrix representation, which has also been used by Schützenberger, and a lemma recognized by Chakrabarthi. Let the matrix (pq) represent the configuration of v elements and b sets, p being the index number of a set and q the index number of an element contained in a set, the sets and elements being numbered in any manner consecutively. The dual configuration can be represented by the transposed matrix (qp) . The proof of the following theorem is then straightforward:

"If a_{ij} be the number of elements common to the i th and j th sets of an incomplete block design, each element occurring in r blocks and each pair of elements in λ blocks, then the square matrix of b rows formed of the elements, a_{ij} , is the product of the matrix (pq) of b rows and v columns and its transpose (qp) of v rows and b columns where we write 0 in the empty spaces of the matrices and 1 in the occupied spaces."

Consider the determinants derived from the matrices, where the necessary number of zero rows or zero columns are added if $b \neq v$ to make it square. Hence, $|a_{ij}| = 0$ if $b \neq v$ and a_{ij} is a perfect square if $b = v$.

In the case of the symmetrical block design, $a_{ij} = \lambda$ ($i \neq j$) and $a_{ii} = k = r$ and in the other case, at least two a_{ij} 's are unequal. The proof of this and also of the relation $v \leq b$, is obvious from the following identity proved by the author,⁴

$$\sum (a_{ij} - a_{ik})^2 = (k-1)(r-k)(r-\lambda)^2 \leq$$

where i is fixed and j, k run over all values except i not exceeding b . The value of the determinant $|a_{ij}|$ in the symmetrical case is a particular case of that given by Salmon⁶ and can be shown to be equal to $r^2(r-\lambda)^{r-1}$.

A. A. KRISHNASWAMI AYYANGAR.

Andhra University,

Waltair,

January 14, 1951.

1. Ayyangar, A. A. K., and Srinivasan, A. K., *Proc. 33rd Ind. Sci. Cong.*, 1946. 2. Schützenberger, M. P., *Annals of Eugenics*, 1949, 14. 3. Chakrabarthi, M. C., *Bull. Cal. Math. Soc.*, 1950, 42. 4. Ayyangar, A. A. K., *J. Mysore Univ.*, 1943, 3. 5. Bose, R. C., *Proc. 34th Ind. Sci. Cong.*, 1947. 6. Salmon, G., *Lectures Introductory to, Modern Higher Algebra* (Reprint, 1924).

RAMAN SPECTRUM OF APOPHYLLITE

APOPHYLLITE ($\text{KF Ca}_4 \text{Si}_8 \text{O}_{20} \cdot 8\text{H}_2\text{O}$) is unique among the silicates in that it bears a close resemblance to the micas in its structural characteristics, while like the Zeolites it is capable of giving off its water-content on heating and reabsorbing it on cooling. Only a study of the dehydration curve and the optical anomalies exhibited by apophyllite are on record. If Pauling's rule is to be obeyed, the water content in this crystal has to be incorporated as HO-H-O groups rather than in the customary way. This seems to be corroborated by the

appearance of only one high frequency shift Raman line in its spectrum.

The Raman spectrum of a natural specimen of apophyllite was photographed using the $\lambda 2537$ radiation of a quartz mercury arc as exciter. The incident light was normal to the (001) cleavage face, while the scattered light was gathered edgewise along [100] direction. Its spectrum consists of 19 lines with frequency shifts 90 (1), 108 (3), 138 (2), 166 (1), 187 (1), 209 (2), 232 (1), 280 (1), 307 (2), 344 (2), 355 (1), 433 (1), 488 (2), 541 (2), 586 (2), 820 (1), 1080 (5) and 3520 (10), the first 18 of which are reproduced in the accompanying figure. It is found that while the lines 90, 166, 209, 232 are depolarised, lines 108, 138, 187, 1080 and 3520 are strongly polarised when unpolarised light is incident along the optic axis and the scattered light is taken normal to the (100) cleavage face.

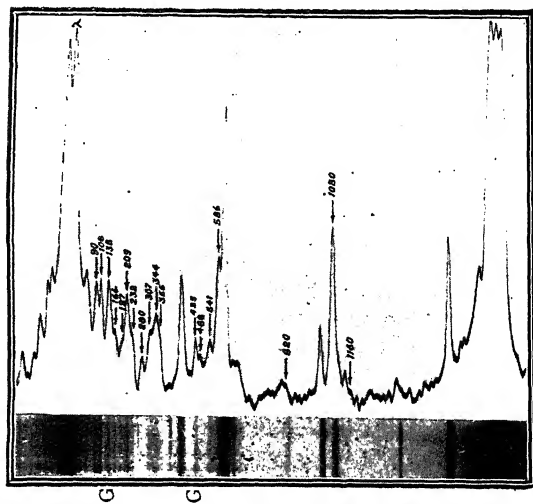


FIG. 1

(a) Raman Spectrum of apophyllite taken with $\lambda 2537$ excitation.

(b) Its Microphotometer record.

The structure of apophyllite is based on linked silicon oxygen sheets of a tetragonal type, the adjacent sheets being linked by cations (Ca, F and K) on reflection planes. A calculation of the possible number of vibrations of the different symmetry types of the two molecules contained in the unit cell show that as many as 103 frequencies may be expected to appear in Raman effect. Also in the particular orientation studied, all except the 41 frequencies of the degenerate class E should be fully polarised and as such a tentative assignment can be made as given below.

Symmetry type	A_{1g}	B	E_g
Frequency observed	3520	108, 138	90, 166, 209
	1080	187	232

The author is grateful to Prof. R. S. Krishnan for suggesting the problem.

Physics Dept., P. S. NARAYANAN.
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March 14, 1951.

1. Taylor, W. H., and St. Náray-Szabó, *Zeits für Krist.*, 1931, 77, 146.

SCHILLER IN MOONSTONE

I HAVE read with interest the article on the above subject in the October 1950 issue of *Current Science* and also the original paper referred to therein.¹ Some of their references are to earlier work carried out by me, and as I cannot fully subscribe to the interpretations or the conclusions arrived at, I would welcome this opportunity to discuss these in your journal.

I. *Schiller Plane or Schiller Axis*.—The schiller plane of the potash-soda moonstone feldspars has been measured by a number of workers² (and see reference therein pp. 309-10). The values obtained by them vary between the angles of 72° and 75.5° as measured on the trace of 001, the plane cutting the c-axis negatively and being perpendicular to 010. The mean value obtained by me for Ambalangoda moonstone was 73.53° and with $\beta = 63.57^\circ$ the plane thus makes an angle of 9.56° with the c-axis. Raman, Jayaraman and Srinivasan prefer to make use of the schiller axis, i.e., the normal to the schiller plane. They give the direction of this schiller axis as 81° to the c-axis and state that the schiller plane makes an angle of 9° with 100 that is with the c-axis. In view of their cursory reference to other determinations of this schiller plane, it is surprising that no information is supplied as to how their own measurements were made. Moreover, without qualification their figure of 81° to the c-axis is ambiguous as it includes two arbitrary directions. However, it is fairly certain that the direction obtained by them is in the same sense as that of previous workers, i.e., that the schiller plane cuts the c-axis negatively. If this is the case, their value of 9° is very close to the figure of 9.56° obtained by me. The difference is probably well within the limits of their experimental error. Again, within the limits of experimental error, this plane is iden-

tical with the mean plane in which the micro- and crypto-perthitic structures lie in these potash-soda moonstone feldspars, as measured by various workers.

II. *Micro- and Crypto-Perthitic Structure and Schiller*.—Raman, Jayaram and Srinivasan discount the suggestion that the schiller of these blue and white moonstones is connected with the perthitic structure, stating "the coarse structure of which indications are observed under low powers of the microscope in certain other cases is *prima facie* incapable of giving rise to the optical phenomena under consideration". But is this the case? The micro- or crypto-perthitic structures described and photographed by me² (pp. 302-12 and plates) in the blue-white Ambalangoda moonstones show lamellæ ranging in thickness from .001 millimetre downwards the majority lying between .001 and .0005 millimetre. Now .0005 millimetre is below the wave-length of the middle part of the visible spectrum, and it will be evident from the description referred to above that this value cannot represent the lower limit of thickness of these lenses or films. These lamellæ are not flat plates as the writers apparently assume them to be, but are in reality flattened cigar or pencil-shaped bodies tapering away at the edges. Their length—in the plane of 010—is roughly 50 times and the breadth—along the b-axis—is about 10 times the mean thickness. They tend to finger off in the b-axis direction along prism planes.

I submit that these dimensions are of a much lower order than that indicated by the above quotation and that they lie within the limits required for producing the blue to white schiller by the scattering and reflection of light by these bodies.

The writers make a strong point of their observation that the schiller range is several times greater when measured on the c-axis of rotation than when b is the rotating axis. I submit that this is precisely what one would expect if the schiller is due to the minute lenticular bodies described above, with a length much greater in a direction perpendicular to the b-axis than is their breadth parallel to this direction.

The fact that moonstones with white schiller show relatively coarser and more sharply defined micro- and crypto-perthitic structures would also follow from the increasing proportion of the visible spectrum scattered and reflected by these minute bodies.

It may be said that of the many hundreds of transparent or semi-transparent micro- and

crypto-perthitic soda-potash feldspars which I have examined under the microscope not one has failed to display a schiller, either blue, blue-white or white. The same applies to those micro-perthitic microclines sufficiently clear or translucent along the *a*-axis direction to permit of internal reflections.

III. *X-Ray Heterogeneity*.—Raman, Jayaraman and Srinivasan agree with previous investigators that these Ambalangoda moonstones show X-ray heterogeneity although they draw attention to a paper by Chao and Taylor⁵ in which "certain specimens of moonstone show a faint schiller but give no trace of additional X-ray reflections".

This paper discusses the X-ray examination of eleven potash-soda feldspars supplied by me to Taylor. Eight of these specimens show blue or white schiller and only the one lowest in soda, namely, specimen D with a faint blue schiller, definitely fails to show a double X-ray pattern, with the next specimen on the list, namely E, doubtful. These two specimens contain only 14% and 16.5% of soda feldspar respectively as against 30 to 40% in Ambalangoda moonstone. Yet both of these show micro- to crypto-perthitic structures under the microscope with optimum illumination conditions, specimen D faintly and specimen E fairly strongly. I have recently confirmed my original observations from portions of these specimens still in my possession. Of the remaining six specimens which show definite X-ray patterns and micro- to crypto-perthitic structures, two are Ambalangoda moonstones.

IV. *Apparent Monoclinic Character of the Soda-Potash Feldspars*.—Reference is made by the writers to a paper by Ito⁶ in which the segregation of the soda feldspar component in moonstone is stated to be such as to make a near approach to the structure and symmetry of orthoclase. This apparent monoclinic character, even with relatively coarse perthitic moonstones was pointed out by me as early as 1930² (p. 306) and discussed in later papers³ (p. 485) and⁴ (pp. 88-89). Monoclinic symmetry could be simulated by twinning of the triclinic soda feldspar component, but the micro-perthitic schillerised potash-soda feldspars show no visible evidence of twinning and their behaviour towards heat treatment indicates that the soda feldspar component is different from true albite.

E. SPENCER.

February 9, 1951.

Min. Mag., 1930, 22, 291. 3. —, *Ibid.*, 1937, 24, 453. 4. —, *Ibid.*, 1938, 25, 87. 5. Chao, S. H., Smare, D. L. and Taylor, W. H., *Ibid.*, 1939, 25, 338. 6. I to T. I., *X-Ray Studies on Polymorphism*, Marusen Co., Tokyo, 1950.

THE STRUCTURE AND OPTICAL BEHAVIOUR OF THE CEYLON MOONSTONES*

I. THE visual observations described in our paper under this title, and the photographs reproduced in an article appearing in the present issue of *Current Science* prove that the schiller exhibited by the Ceylon moonstones is very far indeed from being a geometric reflection of light within the crystal. Actually, it is a diffusion of light visible in all directions, the greater part of the energy diffused being, however, concentrated within a fairly defined area extending over several degrees of arc each way. The distribution of intensity in these diffusion patterns and the manner in which the patterns shift with the setting of the crystal are most conveniently described in terms of the "schiller axis" which is a particular direction within the crystal. Since there is no geometric reflection, the "schiller planes" are purely hypothetical and the use of the term to describe the phenomena seems to us to be misleading.

II. From a study of the shape and angular extension of the observed diffusion patterns, well-understood principles of optical diffraction theory enable us to deduce the linear extension of the elements in the heterogeneous structure responsible for the diffusion of light. Table I gives the average values determined by us in this way from a study of numerous specimens.

TABLE I

Colour of the Schiller		Major axis	Minor axis
Blue	..	1.6 μ	0.8 μ
Bluish-white	..	3.0 μ	1.6 μ
White	..	6.0 μ	5.0 μ

The lengths shown in the second and third columns of Table I are transverse to each other and to the direction of the schiller axis. The maximum difference in refractive index arising from the local variations of chemical composi-

* Our paper under this title [appeared in *Proc. Ind. Acad. Sci.*, 1950, 32, 123-40.

The paragraph numbering in the present note follows that appearing in Dr. E. Spencer's letter to which it is a reply.

tion of the feldspar is of the order of 0.01. Multiplying this by the lengths shown in Table I, it is seen that the optical path-differences arising in the passage of light through an *individual* element in the structure would, in all cases, be only a small fraction of the wave-length of light. One has also to consider the confusion arising from the overlap of the phase-differences due to the elements successively traversed by the light. In these circumstances, it does not seem possible that the heterogeneity of structure actually responsible for the schiller effect would visibly manifest itself under the microscope.

The structures observed by Dr. Spencer under certain conditions of illumination and under low powers of the microscope have dimensions ranging from 50μ downwards in one direction and from 10μ downwards in the transverse direction. These are far larger than the sizes indicated by the diffusion patterns and shown in Table I. The remark made by us in our paper that such structures are *prima facie* incapable of giving rise to the optical phenomena under discussion seems to us in the circumstances fully justified.

III. The features of the structure which are responsible for the appearance of the optical diffusion patterns studied by us are presumably also responsible for the observed peculiarities in the X-ray patterns. We make this statement with due reserve, since, as stated in our paper, further investigations are necessary to establish the correctness in a conclusive manner.

IV. Prof. Ito states clearly in his paper that the structure of the Korean moonstones studied by him is beyond the resolving power of a microscope. The samples of the material which he has kindly sent to us are beautifully crystallised and transparent specimens. We see no reason to believe that either the schiller which they exhibit or the special features observed in their X-ray patterns arise from coarse structures of the kind found in the micro-perthitic feldspars.

C. V. RAMAN.

Bangalore,
April 14, 1951.

A. JAYARAMAN.

T. K. SRINIVASAN.

RELATION BETWEEN BOND COMPOSITION AND CRUSHING STRENGTH OF SAND LIME BRICKS

THE bond in sand lime bricks is mainly made of 3CaOSiO_2 and $15\text{CaO Al}_2\text{O}_3 \cdot 5\text{SiO}_2$. An empirical formula shown below gives roughly the relation between the nature and composi-

tion of the bond and crushing strength of the brick.

Crushing strength in lb./sq. in. = $400\text{ T.S.} + 720\text{ A.S.}$, where T.S. and A.S. represent the percentages of lime in the aggregate present as tricalcium silicate and calcium aluminosilicate respectively.

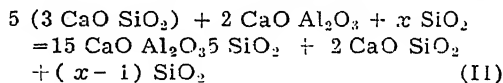
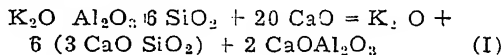
Bricks were made using pure lime and sand under a pressure of 2 tons per sq. in. and steamed for 8 hours at a pressure of 100-125 lbs./sq. in. The time lapse between the determination of the crushing strength and the preparation of the brick was ordinarily about 15 days. The crushing strength of the bricks progressively increased with increase in the proportion of lime. Assuming that whole of lime

TABLE I

%Lime in aggregate	Crushing strength in lb./sq. in.	
	Observed	Calculated
5	1942	2000
6	2391	2400
7	2693	2600
8	3158	3200
12	4894	4800

is present as tricalcium silicate the crushing strength according to the formula is equal to $400 \times$ percentage of lime. Both the calculated and observed values are given in Table I and show fair agreement.

Venkatesham² prepared superior quality sand lime bricks using sludge after extraction of potash from felspar mixed with suitable amount of sand and water. The work under progress³ in these Laboratories leads us to conclude that calcium oxide reacts with felspar according to equations I and II:—



One molecule of $15\text{CaO Al}_2\text{O}_3 \cdot 5\text{SiO}_2$ and one molecule of 3CaO SiO_2 are produced from each molecule of felspar. The extent of the decomposition of felspar depends on the purity of lime (Table II). The composition of the sludge being thus fairly known it is possible to find out the amount of tricalcium silicate and calcium aluminosilicate in the bricks. The values of crushing strength calculated from the formula are in close agreement with the experimentally observed values (Table II).

TABLE II

% Purity of lime	% decomposition of felspar	% lime as		Crushing strength lb. sq. in.	
		T.A.	A.S.		
90	90.8	1.26	6.31	5130	5047
70	76.0	0.974	4.87	3829	3896

Thanks of the authors are due to Dr. S. Husain Zaheer for his keen interest.

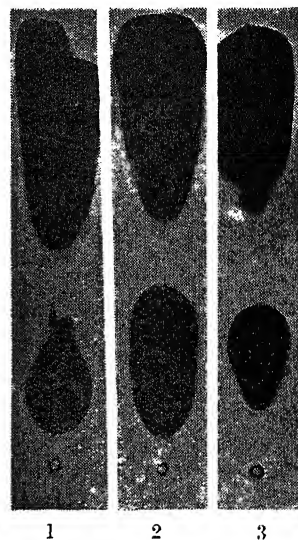
Central Laboratories for D. S. DATAR.
Scientific & Indstl. Res., B. S. R. SASTRY.
Hyderabad (Dn.),
December 11, 1950.

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A MODIFIED AUTOBIOGRAPHIC TECHNIQUE FOR THE LOCATION OF "PHYSIOLOGICALLY ACTIVE" SPOTS ON PAPPYROGRAMS

IN the course of our studies on the papyrographic separation and quantitation of antibiotics, vitamins and other growth factors, we were confronted with the problem of locating the 'physiologically active' spots on the papyrogram by the technique of bio-autography. Since rectangular dishes (45 × 25 × 2 cm.) usually employed for such tests^{1,2} have not been readily available to us, we tried to use stainless steel 'Dishes' (40 cm. × 10 × 2 cm.) made to similar specifications. Our first trials with penicillin papyrograms developed according to the micro-method of Rockland and Dunn³ as modified by Govindarajan and Sreenivasaya,⁴ showed that it was difficult to locate the "active" spots. The technique was, therefore, modified by first layering the "dish" with a rectangular sheet of cellophane, with its two shorter ends over-reaching the lip of the dish. The nutrient agar medium inoculated with *S. aureus*, was then poured on to the dish and allowed to set. The papyrograms (1 cm. × 19.5 cm.) after developing were placed on the agar surface, gently pressed with a flattened glass rod to facilitate intimate contact of the paper and allowed to remain there for 30 minutes. During this period, the active principles from the 'spots' were expected to diffuse into the agar. The strips were then removed and the test "dishes" incubated at 37° C. for 18 hours,

With the help of the extra length of cellophane allowed to over-reach the lips of the dish, the agar layer can be easily lifted and held vertically for inspection. The "active" spots can be easily located as clear and transparent spots on the agar layer. Permanent records of such papyrogram preparations can be obtained by making contact prints on "Ilford reflex contact Document No. 50" (see Fig. 1).



Penicillium Notatum grown on the basal medium, supplemented with:—

1. Lac Washings.
2. Aqueous green gram extract.
3. Enzyme-free moldy bran extract.

Circles in the figure represent the areas spotted with the beer.

This method has been successfully applied for the characterisation and quantitation of the penicillins in the fermented beers and also, for the separation and identification of growth factors in the physiological fluids and tissue extracts.

Our grateful thanks are due to Prof. M. S. Thacker, our Director, for his kind interest.

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April 6, 1951.

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ANALYSIS OF SUGARS USING PAPER
CHROMATOGRAPHY (CAPILLARY
ASCENT)

DURING the course of our investigations on natural carbohydrates, we have had occasion to analyse a number of sugar mixtures and uronic acids, adopting Williams and Kirby's technique of ascending paper chromatography.¹ However, filter-paper strips (10 cm. \times 36 cm.), perpendicularly hung from a frame, were used instead of the filter-paper cylinders which sometimes shrivel or even collapse. Irrigation with the solvent was allowed to proceed till the solvent front reached a height of about 28 cm., which usually took 14 to 18 hours depending on the nature of the solvent. The development of the spots was done by spraying with aniline hydrogen phthalate which was found to be much better than ammoniacal silver nitrate.² The use of alkaline potassium permanganate as a developer³ was not satisfactory. The R_F values obtained differed in many cases from those calculable from the graph recorded by Wolfson, Cohn and Devaney⁴ (actual values not given), but were in general agreement with the figures obtained by Partridge according to the solvent-descending method.⁵

TABLE
(R_F Values obtained at 20° C.)

	With water-saturated phenol		With water-saturated collidine	
	Partridge's values	Our values	Partridge's values	Our values
<i>d</i> -Glucose	0.39	0.38	0.39	0.39
<i>d</i> -Galactose	0.44	0.43	0.34	0.35
<i>d</i> -Mannose	0.45	0.43	0.46	0.45
<i>d</i> -Xylose	0.44	0.44	0.50	0.50
<i>d</i> -Arabinose	0.54	0.53	0.43	0.42
<i>l</i> -Rhamnose	0.59	0.60	0.59	0.58
Lactose	0.28	0.36	0.24	0.23
Maltose	0.36	0.36	0.32	0.30
<i>d</i> -Galacturonic acid	0.13	0.13	0.14	0.13
<i>d</i> -Glucuronic acid	0.12	0.11	0.16	0.15

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March 7, 1951.

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R. M. BERI.

ELECTRODEPOSITION OF COPPER-
TIN ALLOYS FROM FLUOBORATE
BATH

BRIGHT and adherent deposits of copper-tin alloys are obtained from the stannate-cyanide bath. The stannate-cyanide bath requires careful control of bath composition and anode current densities, when individual anodes are employed. The fluoborate bath employed by the present author has decided advantages over the one mentioned above. From the fluoborate bath containing both the metal fluoborates in solution, deposits similar to those obtainable from the stannate-cyanide bath, can be obtained. The preparation, operation and maintenance of the bath is simple. The bath is stable over long periods of operation in the presence of excess of free fluoboric acid. The accompanying table indicates the variation in composition with changes in current density and metal content of the bath:

Sn 31.18 g./L. Anodic current density on
in bath Cu = 5.75 amp./sq. ft.
Interanode distance 2" Room temp. 23°C.
Anode cathode distance 3."

Copper content of bath	Anodic current density: Tin (amp./sq. ft.)	Metal content of the deposit (%)	
		Cu	Sn
3.98 g./l.	5.75	21.4	71.6
	8.60	10.0	90.0
	11.50	9.5	90.5
7.95 g./l.	5.75	50.0	50.0
	8.60	40.0	60.0
	11.50	31.0	69.0
15.90 g./l.	5.75	82.7	17.3
	8.60	73.2	26.8
	11.50	56.2	43.8

The deposits obtained from the bath are fine, adherent and easily polished. The throwing power of the bath is satisfactory. From the table it will be seen that satisfactory deposits of any composition between 17.3% Sn — 82% Cu and 90% Sn — 9.5% Cu can be readily obtained. Deposits obtained beyond the range of c.d. mentioned are coarse and non-adherent. No appreciable change in composition of the deposit from that obtained at room temperature has been observed when the bath is operated at temperatures up to 60° C. Mild agitation has no influence on the composition of the deposit.

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February 7, 1951.

J. BALACHANDRA.

1. Williams, R. J. and Kirby, H., *Science*, 1948, **107**, 481. 2. Partridge, S. M., *Nat.*, 1949, **164**, 443. 3. Pacsu, E., Mora, T. P. and Kent, P. W., *Science*, 1949, **110**, 446. 4. Wolfson, W. Q., Cohn, C. and Devaney, W. A.; *Ibid.*, 1949, **109**, 541. 5. Partridge, S. M., *Biochem. J.*, 1948, **42**, 238.

**DICHOCROCIS PUNCTIFERALIS
GUENEE (CASTOR POD BORER) ON
ANDROPOGON SORGHUM BROT IN
MYSORE**

Dichocrocis punctiferalis Guenee has been chiefly a castor pest, its caterpillars boring into castor pods and occasionally stems and constructing a slight webbing with frass particles on the shoots and seed capsules in a bunch.

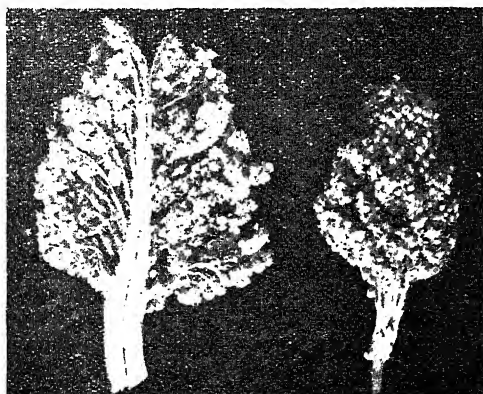
Lefroy (1907, 1909) stated its food plants to be castor, sunflower head; cacao pods (in Ceylon); and "kaikar" fruits of *Garuga pinnata*.

Fletcher (1914) listed the host range as "Castor stem and pods, turmeric stem, ginger stem and rhizome, guava fruits". He further stated: "Outside Southern India, it has been reported as attacking mango flowers, cholam heads, peaches, cacao pods, cardamom capsules, etc."

Mohan Singh (1941) recorded it on hollyhock.

In Mysore we have noted this insect to infest tamarind fruits, mango flowers, pomegranate fruits, and also bore into cardamom stems in nature.

Recently in the course of our work on sorghum webbing caterpillars, *Dichocrocis punctiferalis* Guenee was found on the earheads of *Andropogon sorghum* Brot, in the laboratory compound of this Department, damaging the grains in the same way as the sorghum (Jawar) webbing caterpillar—*Stenochroia elongella* Hampson, common in Mysore. The caterpillars on the earheads were very well developed and seemed to prefer this host, in that the earheads were reduced into a powdered mass of grains and frass. The extent of damage can be made out from Figs. A and B.



A. Infected *Sorghum* earhead.

B. Infected *Sorghum* earhead split open to show nature of damage. (Much reduced).

While continuing its study, we have been able to rear them also on stored grains of sorghum and also on rice bran. But these two food media were not equally well preferred.

Though we have noted this pest for the first time on sorghum it has not been taken on this crop in the fields. But it is interesting to note its wide host range—oilseeds, fleshy stems and fruits, flowers and dried cereal grains.

Sorghum is grown extensively in Mysore and is a staple food crop. It is usually subjected to the ravages of the webbing caterpillar, *Stenochroia elongella* Hampson, a major pest on the hardened grains in the earheads, in Mysore District. Castor is also a major oil seed crop in Mysore. Though the latter is grown as a seasonal crop in the fields, perennial castor plants exist in the backyards of village houses. The season of the two field crops—sorghum and castor, differs; the former is sown in March–April and harvested in August–September and the latter comes to bear pods later. The absence of the castor pod borer on sorghum in the field, may be due to the seasonal variations of the two crops. But there is every possibility of the pest extending from the perennial castor plants grown in village backyards, to sorghum earheads in the field as infected pods can be found throughout the year. It is also possible that this pest may invade the stored grains from field infections.

With its extensive host range and varying feeding habits, this insect must be viewed as a potential economic pest of cereal food crops. The damage would be much more serious when it breaks out along with the usual webbing caterpillar—*Stenochroia elongella* Hampson.

As a preventive measure against the spread of this pest, perennial castor plants in village backyards must be examined more often and infected pods destroyed by burning.

Detailed biology and bionomics of this pest are being studied.

We are grateful to Mr. B. Krishnamurthy, Government Entomologist, for help and constructive criticism.

Entomological Lab., M. PUTTARUDRIAH.
Dept. of Agric., G. P. CHANNABASAVANNA.
Bangalore,
January 15, 1951.

1. Fletcher, T. B., *Some South Indian Insects*, 1914 (Government Press, Madras), 433.
2. Lefroy, H. M., *Mem. Dept. Agri. Ind. Ent. Ser.*, 1907, 1 (2), 211.
3. —, *Indian Insect Life*, 1909 (Thacker Spink & Co., Calcutta), 517.
4. Mohan Singh, *Ind. Jour. Ent.*, 1941, 3 (1), 141.

POTATO PYROPHOSPHATASES

A LABILE alkaline pyrophosphatase, activated by Mg^{++} ions, was first demonstrated in erythrocytes,¹ and it was suggested^{2,3} that this enzyme for its activity requires SH- and NH_2 groups. Similar enzyme was found in many animal tissues excepting bone.⁴ A search was made to find whether such an enzyme is distributed in vegetable kingdom also. Successful results were obtained with potato.

There are only few reports on vegetable pyrophosphatases,^{5,6,7} but in all these cases the enzymes had an activity optimum in acid pH. Potato is found to contain, besides several enzymes, a phosphomonoesterase,⁵ a pyrophosphatase,⁵ and an apyrase,⁸ and here also all these three enzymes have an acid optimum pH. So far the alkaline pyrophosphatase in potato or in vegetable tissues was not investigated.

EXPERIMENTAL.—Skinned potato was cut into chips and crushed in a mortar, and ground well with twice its weight of cold double-distilled water. The extract was centrifuged, and with the clear supernatant the enzyme activity was determined at different pH values with and without added magnesium ions.

TABLE I

pH	Without added magnesium γ P liberated	With magnesium γ P liberated
2.62	nil	nil
3.20	8	..
3.62	26	..
3.88	39	..
4.13	52	45
4.33	65	..
4.66	68	..
4.93	72	57
5.32	66	..
6.12	52	16
6.75	35	31
6.99	26	..
7.25	20	..
7.42	14	46
7.66	11	..
7.90	9	..
8.18	4	..
8.55	6	78
8.16	3	81
9.64	nil	77

A mixture of 3 ml. of veronal-acetate buffer (M/35), 1 ml. $MgCl_2$ (M/10) or water, 0.5 ml.

of $Na_2P_2O_7$ (M/100) was brought to 38° C., and 0.5 ml. of the enzyme solution was added, and incubated for exactly 15 minutes at 38° C. The enzyme activity was stopped with 2.5 ml. of 10% trichloroacetic acid, filtered, and the *ortho*-phosphate determined in the filtrate. The results are given in Table I.

From the table it could be seen that the alkaline pyrophosphatase is inactive in the absence of magnesium, but exerts its maximum activity between pH 8.55 to 9.64 in the presence of 0.01 to 0.1 M. magnesium. With 0.001 M. or below of magnesium the activity is nil.

The enzymes can be purified by fractionation with amm. sulphate. The protein precipitated at 0.3 saturation showing negligible activity was discarded. The supernatant was brought to 0.6 saturation and the precipitated protein dissolved in water when a clear solution was obtained. This fraction contained most of the enzyme systems of the crude extract.

Studies on this purified preparation revealed that the acid enzyme has a broad activity optimum ranging from pH 4.33 to 6.75. It is therefore concluded that the crude extract contains some factors which inhibit the activity between pH 6.12–6.75. These factors seem to be absent or present only in small amounts in some batches of potatoes where the broad optimum was obtained. Most of the alkaline enzyme is present in the purified preparation, but the activity at pH 3.62 was very much reduced. Attempts at further purification by acetone precipitation resulted in loss of most of the alkaline enzyme, though the acid enzyme is not affected.

The alkaline enzyme is very unstable, and this spontaneous inactivation is more pronounced in acid medium (pH 5). Calcium acts as a competitive inhibitor producing more than 80% inhibition when Ca/Mg is 0.1. Cu, Fe, Zn, HCHO, produce marked inhibitions at low concentrations. The Cu inhibition is reversible with cysteine, indicating thereby that thiol groups are essential for the enzyme activity. Formaldehyde inhibition suggests that amino groups also are essential. Thus the potato alkaline pyrophosphatase is very much similar to the erythrocyte and other animal tissue alkaline pyrophosphatases.

Comparing HCHO and Cu inhibitions of the alk. enzyme of the crude and the purified extracts it was found that the crude preparation suffered greater inhibition with HCHO, and very slight inhibition with Cu. There seem to be some factors in the crude extract which

form complexes with Cu and thus make the inhibitor ineffective.

Dept. of Chemistry,
Madras Veterinary College,
Vepery, Madras 7,
January, 1951.

B. NAGANNA.

1. Naganna, B. and Menon, V. K. N., *Curr. Sci.*, 1947, **16**, 226.
2. —, *J. B. C.*, 1948, **174**, 501.
3. Naganna, B., *Ibid.*, 1950, **183**, 693.
4. —, Paper communicated to *Curr. Sci.*
5. Pfankuch, E., *J. Physical Chem.*, 1936, **241**, 34.
6. Giri, K. V., *Ibid.*, 1937, **245**, 185.
7. Jean Courtios, *Fizyologia*, 1937, **1**, 377.
8. Krishnan, P. S., *Arch. Biochem.*, 1949, **20**, 261.

AIR LAYERING IN LITCHI WITHOUT SOIL OR WATER

LITCHI is commonly propagated in India by air layering; but extensive watering is essential to get the desired grafts. Besides, many of the layers heal over and fail to produce roots, simply because they could not be watered so frequently as they ought to be.

Recently, it has been reported from Florida that ornamental plants have been air-layered with the help of sphagnum moss and air wrap (a special plastic material which allows exchange of respiratory gases but no loss of moisture) without watering the layers at all. This method was therefore tested for Litchi.

Shoots of all important varieties of Litchi growing at this Station were air-layered (in July 1950) when the weather was quite wet. Vigorous terminal branches, 18" to 24" in length, preferably with a fork near the top were selected. A ring of bark about one inch in diameter was removed and well scraped to make sure that there was no cambium left. Rootone (a well-known commercial product) was applied to the upper edge of the ring which was covered with thick damp sphagnum moss. Air wrap was then placed around moss and wrapped in such a manner that it was relatively air tight. Holding in this position each end was tied with rubber band. Watering was completely withheld.

After one and a half months, roots developed on the layers and were visible through the air wrap. They were left there for another fortnight when roots of good length had formed on each one of them. They were then detached from the mother plant and potted.

Govt. Fruit Res. Station, L. B. SINGH.
Saharanpur, U.P.,
January 19, 1951.

THE CHROMOSOME NUMBERS IN THE FAMILY ANONACEAE

A NOTE was published by one of the authors (R.D.A.), jointly with Prof. J. J. Asana,¹ on the chromosome numbers in the family Anonaceae. Since then, Bowden^{2,3} figured the chromosome complements of some more species in the family.

The family Anonaceae has an important phylogenetic position and it is very desirable that the number and the morphology of the chromosomes be described in more genera of this family.

The present authors worked on *Cananga odorata*, H.f. & Th. and *Saccopetalum tomentosum*, H.f. & Th. The former is available in the gardens and the latter grows wild in Bombay and its environs. The haploid and diploid chromosome numbers found in *Cananga odorata*, H.f. & Th. were eight and sixteen respectively. These numbers agree with the counts given by Bowden.^{2,3}

In *Saccopetalum tomentosum*, H.f. & Th. the haploid number, as observed at diakinesis, I and II metaphase in the pollen mother cell



FIG. 1. *Saccopetalum tomentosum*, First metaphase plate. ($\times 2775$).

nuclei and I metaphase of the megasporocyte nuclei, was found to be nine (Fig. 1). The haploid chromosome number for this genus has been recorded here for the first time.

M. M. Arts College and R. D. ADATIA.
N. M. Institute of Science, D. B. CHOKSHI.
Andheri (Bombay),
January 2, 1951.

1. Asana, J. J. and Adatia, R. D., *Curr. Sci.*, 1945, **14**, 74-75.
2. Bowden, W. M., *Amer. Journ. Bot.*, 1945, **32**, 81-92.
3. —, *Ibid.*, 1948, **35**, 377-81.

PROPAGATING JACKFRUIT ARTOCARPUS INTEGRIFOLIA BY AIR-LAYERING WITH HORMONES

AIR-LAYERING of jackfruit shoots was tried by the author with a view to overcome the serious disadvantages resulting from seed propagation. A large number of two-year old shoots having diameter from 1.4 cm. to 1.8 cm. were air-layered simultaneously by using the following rooting media: (i) Clay and sand; (ii) Seradix A (a commercial product) in the concentrations

of 0.05 per cent. and 0.025 per cent. respectively;
(iii) α -naphthalene acetic acid in the concentrations of 0.05 per cent. and 0.025 per cent. respectively.

The results are summarised below:

Table showing the number of successful air layers in jackfruit by using hormones

Treatment	No. of shoots treated	No. of air layers rooted	No. of air layers died on transplanting	No. of successful air layers
Control (sand and clay)	50	24	14	10
Seradix A. (0.05%)	50	38	18	20
Alphanaphthalene acetic acid (0.05%)	50	30	6	24
Seradix A. (0.025%)	50	36	0	36
Alphanaphthalene acetic acid (0.025%)	50	36	8	28

It may be mentioned that rooting due to application of Seradix A and α -naphthalene acetic acid in concentrations of 0.025 per cent. was profuse as shown in Fig. 1. This profuse

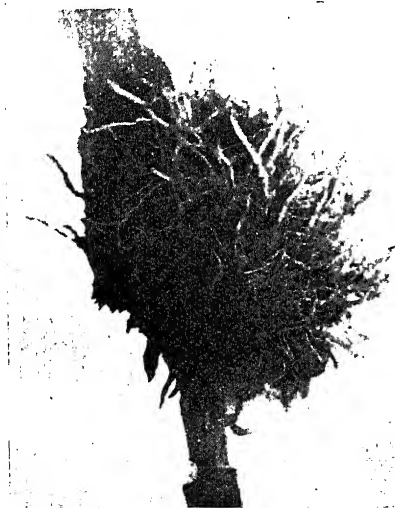


FIG. 1

rooting is possibly responsible for greater survival of air layers in this case, compared with control ones, since their rooting was relatively weak.

These air layers are ready for transplanting in 3 months and reach such length and thickness which a seed-propagated plant attains in 2 to 3 years.

Govt. Fruit Res. Station, L. B. SINGH.
Saharanpur, U.P.,
January 3, 1951.

A SYNCHYTRIUM DISEASE OF UDID BEANS

LEAVES of *udid* beans grown in a garden near Poona were found severely parasitized by a species of *Synchytrium*. Only the lower leaves, being well protected against direct sunlight, were infected and, due to improper leaf-expansion were smaller in size, showing galls on both surfaces. There was no thickening of the leaf tissue in the infected region. The formation of prosorus and sporangial stages has not been observed.

Patel, *et al.*¹ described a leaf-spot disease of *Phaseolus mungo* from Jalgaon, Bombay, caused by a fungus which was identified as *Synchytrium phaseoli* Patel, Kulkarni & Dhande. An examination of authentic material secured through the kindness of Dr. M. K. Patel has revealed that the fungus may not be a *Synchytrium*, since the resting spores are produced in the intercellular spaces of the leaf-mesophyll similar to the oospores of the downy mildews. The fungus under study, represents an undescribed species of *Synchytrium* and its name is proposed in honour of Prof. S. L. Ajrekar. Type is deposited in Herb. Crypt. Ind. Orient., Delhi.

Synchytrium ajrekari Payak & Thirumalachar sp. nov. (Fig. 1).

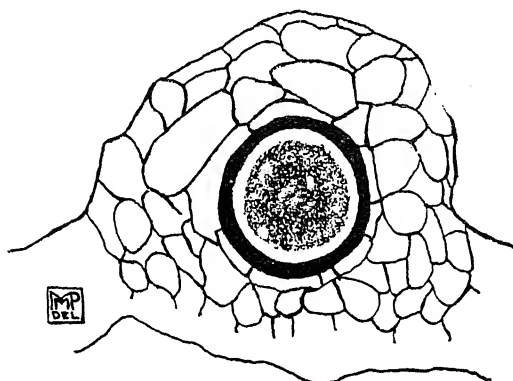


FIG. 1. *Synchytrium Ajrekari* T. S. of Leaf passing Through a gall showing Hypnosporangium $\times 115$.

Galls on the leaves amphigenous, simple, rarely coalescing and compound, appearing as

tiny tubercles. Hypnospores spherical, filling the host cells, golden-brown, $114\text{--}266\mu$ in diameter, surrounded by a hemispherical mound of thin-walled tissue above, thick-walled, wall $8\text{--}11.5\mu$ thick.

Hab. on the lower leaves of *Phaseolus mungo* L. Leg. M. M. Payak, Poona, 12th October 1950.

Gallæ in foliis amphigenæ simplices, raro coalescentes atque compositæ, apparantes ut minuti tuberculi. Hypnosporæ sphaericæ, plantæ hospitis cellulas implentes, aureo-brunnæ, $114\text{--}266\mu$ diam., circumdatæ acervo hemisphaerico texturæ tenuiter supra parietatæ, parietibus crassis præditæ, muro vel pariete $8\text{--}11.5\mu$ crasso.

Hab. in foliis inferioribus *Phaseoli mungo* L. lectus a M. M. Payak, in loco Poona, die 12 Octobris 1950.

The writer is grateful to Dr. M. K. Patel for help in examining the specimens, and to Rev. Father H. Santapau, S.J., Head, Dept. of Biology, St. Xavier's College, Bombay, for the Latin diagnosis.

Botany Lab. of M.A.C.S., M. M. PAYAK.
Law College Building,
Poona,
January 25, 1951.

1. Patel, M. K., Kulkarni, Y. S., and Dhande, G. W.,
Curr. Sci., 1949, 18, 171.

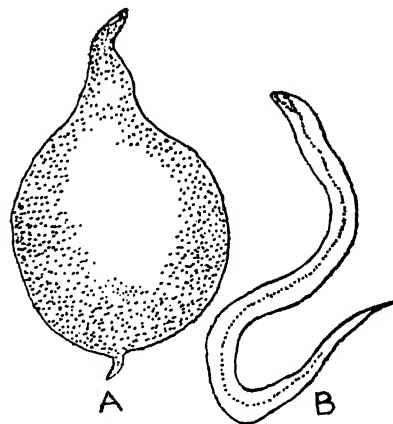
ROOT-KNOT NEMATODE ON POTATO TUBERS IN SIMLA

POTATO TUBERS showing scab-like warts from the Potato Breeding Sub-Station, Simla, on microscopic examination, revealed that the warty galls were incited by the root-knot nematode *Heterodera marioni* (Cornu) Goodey. The disease was reported to be quite severe on the tubers in restricted areas in the Sub-Station.

The nematode infestation on the tuber appears first, as tiny tubercles but heavy and localised infestation, stimulates excessive cell division of the host, leading to gall formation. When an infested tuber is cut across, the female worms of the size of a pin-head may be ob-

served as glistening white bodies embedded within the potato tissue. The adult female worms (Fig. 1) are pyriform, often showing the egg case, which are light-brown to black *en masse*. The male worms (Fig. 2) are fili-form and in general outline does not differ from the larval stages.

The root-knot nematode has a wide range of hosts and can build up to epidemic proportions.



A. Female worm \times about 60.

B. Male worm \times about 80.

Grateful thanks are due to Dr. Pushkarnath, Botanist, Potato Breeding Sub-Station, Simla, for the supplying of diseased material and to Dr. S. Ramanujam, Director, Central Potato Research Institute, for valuable suggestions.

M. J. THIRUMALACHAR.

Central Potato Research Institute,
Patna.

December 26, 1950.

DISEASES OF SPINACH

PADWICK AND KHAN (1945)¹ have reported the leaf-spot of spinach (*Spinacia oleracea* L.), caused by *Heterosporium variable* (*H. variable*) from Srinagar in the Kashmir State.

S. NO.	NAME OF THE DISEASE	CAUSAL ORGANISMS
1.	Damping-off	(i) <i>Pythium de Baryanum</i> . (ii) <i>Fusarium spinaciæ</i> . (iii) <i>Rhizoctonia solani</i> . <i>Cercospora spinaciæ</i> .
2.	Leaf-spot	<i>Alternaria spinaciæ</i> .
3.	Alternaria-blight	<i>Colletotrichum spinaciæ</i> Ell. and Halst.
4.	Anthracnose	(i) <i>Fusarium solani</i> . (ii) <i>Rhizoctonia solani</i> .
5.	Root-rot	<i>Cladosporium macrocarpum</i> .
6.	Black mould	

The detailed investigation of the important diseases of spinach was undertaken during 1947-49 at Kanpur.*

A record of the diseases with their causal organisms is given above.

These are the first records from India.

Full details of this work will be published shortly.

Botany Section, BABU SINGH.
Agricultural College, VIPIN C. GUPTA.
Kanpur,
February 20, 1951.

1. Padwick G. Watts and Khan, M. A., *Notes on Indian Fungi*: III. *Mycological Papers* No. 12, Page 15, 61.
2. Saccardo, P. A., *Syllage Fungorum*, 10, 13.

* Thesis submitted in partial fulfilment of the requirement for the M.Sc., (Agriculture) degree of the Agra University.

CHROMOSOME NUMBERS IN SOME FLOWERING PLANTS

EXCEPT *Cichorium intybus* L., whose doubtful chromosome number has been confirmed here, all other numbers are new as far as known to the author.

Apocynaceæ

Plumeria alba .. $n = 18$ }
 $2n = 36$ }

Plumeria rubra .. $n = 18$

Plumeria acutifolia .. $n = 18$

Carissa carandus Linn. .. $n = 11$

Carissa spinarum Linn. .. $n = 11$

Meliaceæ

Cedrela toona Roxb. .. $n = 28$

Sapotaceæ

Bassia latifolia Roxb. .. $n = 12$

Verbenaceæ

Lantana camara Linn. .. $n = 22$

Acanthaceæ

Sanchesia nobilis .. $n = 68$

Compositæ

Inula indica Linn. .. $n = 9$

Pulicaria crispa Schutz-Bip. .. $n = 10$

Eclipta erecta Linn. .. $n = 11$

Cichorium intybus Linn. .. $n = 9$

Convolvulaceæ

Convolvulus pluricaulis Choisy. .. $n = 10$

I thank Dr. G. N. Pathak for verifying these chromosome numbers.

Govt. Agri. College, BHUPENDRA SINGH.
Kanpur,
December 19, 1950.

PROBABLE BUD SPORTS IN CITRUS

CONSIDERING the importance of bud-sports in citrus,¹ a planned search for them was carried out at this Research Station. So far, the following two important variants in citrus have been noted.

1. *Variant in Citrus Medica* Linn. (*Citron*). *Turanj*.*.—This is a very acidic species of citrus, mostly used for medicinal purposes. Normally, the fruit of this variety is highly warty, very thick skinned and hard to press. The fruit-shape is obovoid with a knob at the terminal end. Locules in the inner chamber are small and broad with dryish vesicles. On an average, the pH of the juice is found to be 2.5 as tested by the pH test papers.

A variant fruit was observed on a twig of the same tree, which was entirely different from the normal, described above. In this case the fruit was smooth skinned and less hard to press. Shape of the fruit was more or less ovoid. In T.S., the skin was about half the thickness of the normal and the locules in the inner chamber were longer and narrower with more juicy vesicles than the normal. The pH was 2.8 showing it to be relatively less acidic. Thus, this is definitely an improvement over the normal type.

2. *Variant in Citrus sinensis* Linn., *Maha variety*, *Whitaker*.—Normally, the shape of the fruits of this variety is globose with smooth to finely pitted outer rind. Base of the fruit is evenly rounded, apex being also rounded with slight depression, having a stylar scar. On an average, the pH of the juice is 4.3 and the fruits are quite seedy.

Two fruits, with entirely different shape, were observed on a limb of the same tree. The shape of these fruits was somewhat pyriform with more or less pitted surface. The base of the fruit was short necked. The pH of the juice in this case was 3.6, thus slightly more acidic than the normal. Moreover, there were relatively less seeds.

The twigs of these two major variants along with other minor variants have been tagged for further observations. A detailed paper will be published in due course.

Fruit Research Station, R. N. SINGH.
Saharanpur, U.P.,
February 12, 1951.

* It is popularly known as *Turanj*.

I. Makowetsky (1929) as quoted by Darlington and Janaki Ammal (1945), *Chromosome Atlas of Cultivated Plants*.

1. Webber, H. J., and Batchelor, L. D., *The Citrus Industry*, 1948, 1, 915-52.

THREE BACTERIAL DISEASES OF PLANTS

WHILE carrying out a plant disease survey in Bombay State, the writers came across three bacterial diseases hitherto unreported from India. Of these the one on *Begonia* sp. resembles that described by Takimoto¹ on a species of the same genus by *Xanthomonas begoniae* (Takimoto) Dowson in all respects.

The symptoms of diseases produced on *Stizolobium deeringianum* Bort. by *Pseudomonas stizolobii* (Wolf) Bergey, *et al.*, and on *Piper betle* L. by *Pseudomonas betlis* (Ragunathan) Bergey, *et al.* are also indistinguishable but the causal organisms are, however, not the same, which has necessitated the establishment of two new species to accommodate these organisms and are described below:

(1) *Xanthomonas begoniae* (Takimoto) Dowson on several varieties of *Begonia* sp. at Poona.

(2) *Xanthomonas stizolobiicola* sp. nov.—Slender rods; mostly single; motile; capsulated; no spore or involution forms; gram negative; not acid fast; aerobic; gelatin liquefied; starch and casein hydrolysed; ammonia and hydrogen sulphide produced; creamy to pinard yellow; glistening, flat colonies with entire margins measuring 8 mm. in 4 days on nutrient and potato dextrose agars; good growth in nutrient broth; acid but no gas in dextrose, lactose and sucrose, but no growth in salicin, when grown in peptone free medium; indol not produced; M.R. and V.P. tests negative; no growth in synthetic asparagine medium; Loeffler's blood serum liquefied in 10 days; nitrates not reduced;

NaCl tolerant upto 3%; lipolytic; optimum temperature for growth between 28-30° C.

Pathogenic on leaves, petioles, stem and leaf edges of *S. deeringianum*. Collected at Bulsar (Surat).

(3) *Xanthomonas betlicola* sp. nov.—Slender rods; single or in pairs; motile; capsulated; no spore or involution forms; gram negative; not acid fast; aerobic; gelatin liquefied; starch and casein hydrolysed; litmus reduced; ammonia and hydrogen sulphide produced; on potato dextrose agar, the colonies are baryta yellow with lobate margins and striations at periphery, measuring 11 mm. after 7 days; good, cloudy, yellow growth in nutrient broth; growth on potato cylinders, copious; acid but no gas in dextrose, lactose and sucrose, but no growth in salicin, when grown in peptone free medium; nitrates not reduced; indol not produced; M.R. and V.P. tests negative; no growth in synthetic asparagine medium; NaCl tolerant upto 3%; Loeffler's blood serum liquefied; lipolytic; optimum temperature for growth between 25-28° C.

Pathogenic on leaves, stems and petioles of *P. betle*. Quite common in betlevine gardens.

Detailed account will be published elsewhere.

Plant Path. Laboratory,	M. K. PATEL.
College of Agriculture,	Y. S. KULKARNI.
Poona,	G. W. DHANDE.

January 8, 1951.

1. Bergey's *Manual of Determinative Bacteriology*. 6th ed. Bailliere, Tindall and Cox, London, 1948.

VISITING SCIENTISTS TO S.E. ASIA

THE UNESCO Office at Delhi has been receiving news of the journey of a number of scientists across the countries of this region on some mission to another part of the world. It has been suggested that they may be induced to stop over for a few days at some places where hospitality can be arranged by interested institutions. Very frequently news of their trip comes at a very short notice and arrangements cannot be completed for eventual visit. Scientific institutions in this region may therefore kindly communicate their interest in the various fields of study and the type of engagements they would like for the visiting

scientists so that tentative lists of institutions in different branches of study may be made ready for future reference. The Office may be also informed if some contribution to their travel expense within the country can also be made available. Many of the recently expected arrivals are American Fulbright professors mostly working in the Philippines and a team of the geneticists on way to a Symposium on Genetics and Evolution in Brisbane in May 1951, organized jointly by the Australian and New Zealand Associations for the Advancement of Science.

REVIEWS

Vector and Tensor Analysis. By Harry Lass.
(McGraw-Hill Book Co.), 1950. Pp. xi + 347.
Price \$ 4.50.

This book is the first to be published in the International Series in Pure and Applied Mathematics designed to meet the needs of students at Honours standard.

The books written primarily for students (including even advanced ones) are generally expected to cover a particular branch of a subject thoroughly. But the author of the book under review has attempted to indicate the use of vector and tensor analysis in geometry, mechanics, electricity, hydrodynamics, elasticity and relativity. He has even included a chapter on the theory of integration covering such topics as point set theory, definition of a Jordan curve, Riemann integral and surface and volume integrals. This should not give the impression that these topics have been covered thoroughly. As a matter of fact, the chapter on integration (38 pages) looks more like a brief resumé. Indeed the whole book may give such an impression. The book is, however, quite useful as additional reading. It shows the student the use of vector and tensor methods in various branches of mathematics and prepares him for advanced reading in theoretical physics. There are very few books serving this need. Prof. Lass's book covers the need admirably. This book can be warmly recommended to all our libraries and students in physics and mathematics.

N. S. NAGENDRA NATH.

New Atoms (Progress and Some Memories).

By Otto Hahn. (Elsevier Publishing Co., Inc., New York; London Agents: Cleaver-Hume Press, Ltd., 42-A, Sout Audley Street, London W 1), 1950. Pp. 184. Price 12 sh. 6 d.

This handy little volume unifies several of Prof. Hahn's publications on radioactivity and allied topics into a single work. The book is divided into four chapters. The first chapter gives the lecture delivered by Prof. Hahn while receiving the Nobel Prize. In this lecture he traces briefly the history of the progress of nuclear physics, starting from the discovery of natural transmutation of uranium and ending with the discovery of its artificial fission. The crucial experiments that had to be

carried out by Hahn and Strassmann in order to establish unequivocally the occurrence of the fission of the uranium nucleus have been described in some detail.

Chapter 2 deals with the various aspects of the discovery of chain reaction in uranium. Detailed reference has been made to the following topics: Difference in behaviour of the U(235) and the U(238) nuclei, the uranium pile, plutonium, potential uses of atomic energy, the atom bomb and the production and uses of radioactive elements. The new synthetic chemical elements which have come into prominence in recent years are dealt with in Chapter 3. They are ten in number and fall into two groups. The elements, 43 (Technetium), 61 (Promethium), 85 (Astatine) and 87 (Francium) from the first group. They fill up of the gap in the existing Periodic Table. The second group comprises the so-called transuranic elements, 93 (Neptunium), 94 (Plutonium), 95 (Americium), 96 (Curium), 97 (Berkelium) and 98 (Californium) which fall in the region beyond the Periodic Table. A short account of the discovery of these new elements, methods of production in weighable quantities and their important properties has been given in this chapter.

In the last chapter which is less scientific in character, the author describes some personal reminiscences from the history of natural radioactivity in which he played a prominent role. His contributions to the knowledge of natural radioactive elements and their disintegration products during the first fifteen years his scientific career have been narrated in a historical sequence. Reference has also been made to some of the important anecdotes connected with the days he spent in Ramsay's Laboratory in London and in Rutherford's Institute in Montreal.

The book under review contains a short, intelligent and masterly account of the modern problems of nuclear physics written by one who is considered as one of the world's outstanding authorities on radioactivity and nuclear research. It is very instructive to the reader to learn at first hand the details of the history of some of the discoveries in this field of research. The book is to be warmly recommended to every atomic scientist.

R. S. K.

Elsevier's Encyclopaedia of Organic Chemistry.

Edited by F. Radt. Series III. Carboisocyclic condensed compounds. Vol. 12B, Naphthalene. A. Compounds containing one naphthalene nucleus. Oxo-compounds (except Quinones). (Elsevier Publishing Co., Inc., New York), 1950. Pp. 2189-2716. Price £14.

In reviewing the third part of Vol. 12B containing pages 1053-2187, it was stated that of the 18 Volumes (*plus* Vol. XIX: Subject Index and Vol. XX: Formula Index) which are to comprise *Elsevier's Encyclopaedia*, Vols. XIV and XIII, Vol. XIIA and Vol. XIIB, Parts 1 and 2, had so far appeared. The book under review is the fourth part of Vol. 12B and deals with aldehydes and ketones (but not quinones) of the naphthalene series. The literature has been consulted until the end of 1944, and for the structure of compounds the literature extends to the beginning of 1950. Compounds containing one or more carbonyl groups in the nucleus or the side chain are described, as well as their derivatives containing alkyl, amino, halogen, hydroxy and nitro substituents. For each carbonyl compound, the usual derivatives, such as anils, oximes, hydrazones and semicarbazones, are mentioned. Hydronaphthalenes containing carbonyl groups and their derivatives are then described. The ketohydronaphthalenes are important intermediates for synthesis, for example in the steroid field, and the comprehensive data now presented on the ketohydronaphthalenes are very valuable.

The remarks made in the earlier review on the thoroughness of the treatment in Elsevier, the logical arrangement and the indices that enable a compound to be readily located, the usefulness of the summaries of subject-matter under major heads, the exhaustive data on chemical, physical and physiological properties, and the excellence of the printing—all these apply equally to the present volume. The subject index, however, can be enlarged with advantage to include more fully the derivatives of the listed compounds that are described or mentioned. Thus methylbenzanthrones and halogenbenzanthrones obtained by the cyclization of benzoynaphthalenes are mentioned in the text, but not in the index; these have appeared in the volume dealing with the benzanthrones, but as cross references between volumes, and considering also the interval before completion of the Elsevier series, a very detailed index for each volume will be of great value.

A few omissions have been noticed. The cyclization of various derivatives of 1-benzo-

naphthalene to the corresponding benzanthrones has been mentioned, but not the cyclization of the parent ketone to benzanthrone; this important dyestuff intermediate is now made from anthraquinone, but the possibility of manufacture from 1-benzoynaphthalene is not ruled out. Attention was drawn in the earlier review to the disadvantages of isolating patent literature in separate volumes; to cite one instance, 1-benzoynaphthalene is considered in detail in the present volume, but patent references (e.g., B.P. 591,610; U.S.P. 2,487,777) to the separation of the compound from the 2-isomer, which is formed simultaneously to the extent of about 20% in the Friedel-Crafts relation between benzoyl chloride and naphthalene, are not mentioned. Apparently for the same reason that it is the subject of patents, no reference is made to the suggested use of 4-benzoyl-1-naphthol and other 4-acyl-1-naphthols as azoic and azo dye coupling components. The Scholl cyclization of 1:4-dibenzoynaphthalene to 3:4:9:10-dibenzopyrene-5:8-quinone is mentioned, but not the technically important cyclization of 1:5-dibenzoynaphthalene to 3:4:8:9-dibenzopyrene-5:10-quinone (Indanthrene Golden Yellow GK). 1:5-Dibenzoynaphthalene is prepared technically by the action of benzoyl chloride and aluminium chloride on naphthalene (D.R.P. 576, 253), but the only methods mentioned are from (a) naphthalene-1:5-dicarboxylic acid chloride and benzene, and (b) 1:5-dicyanonaphthalene and phenylmagnesium bromide.

K. V.

Natural and Synthetic High Polymers. By Kurt H. Meyer. A Text-Book and Reference Book for Chemists and Biologists. Vol. IV of the High Polymer Monograph Series. (Publishers: Inter Science Publishers Inc., New York), 1950. Pp. 891. Price \$15.00.

This book is the revised and enlarged edition of Meyer's book on High Polymers, Vol. IV of the High Polymer series. The text has been almost re-written and has been enlarged by about 200 pages over the previous edition. With a brief introduction pertaining to definition and classification, molecular weight, morphological and thermodynamic approach to the study of high polymer chemistry, the author has divided the subject-matter into eleven well ordered selections. The first 92 pages deal with physical and physico-chemical investigation of polymers in solution and in solid state with X-rays, electron microscope, birefringence and polarized infra-red radiation, with appro-

appropriate theoretical background. Section 2 deals completely with inorganic polymers, chain, net and three-dimensional types. Results of X-ray studies have been critically reported. High polymeric hydro-carbons and their derivatives of the addition polymerization types form an important section of the book. For details, the reader can always go to original papers to which references are adequately given.

Condensation polymers form the next section wherein investigations on polymeric ethers, esters, sulphides, amides, phenoplasts, amino plastics, etc., have been reported. These are admittedly only reports; and as a reference source is fairly adequate. Cellulose and its derivatives have been adequately dealt with in the 5th section. Commercial applications of cellulose products, and mechanical properties of cellulose and its derivatives, as also their mechanical breakdown have been reported on, up-to-date. Among natural high polymers, the largest group is, certainly, the proteins and the author's report on proteins covers over 150 pages. Beginning with an introduction to the constitution of proteins, he discusses different types of proteins, such as fibrillar, globular, conjugated proteins, proteins of marked biological activities and with enzymatic properties, under different sub-sections. Viruses and virus proteins also find a brief mention. Ultra-centrifugal, flow birefringence and X-ray methods have contributed greatly towards the understanding of the shapes and other molecular dimensions of these particles. The author's view, based on the presentation of experimental evidence, that virus particles behave truly as organisms will find wide acceptance. The chapter on proteins ends with the behaviour of proteins in solution.

Properties of high polymers in solution is a very useful chapter as an introduction to that subject and deals with the elasticity and viscosity of such solutions. Readers would do well to supplement their knowledge of this subject by reference to the recent book, Vol. II of the High Polymer series by Mark and Tobolsky.

In the field of synthetic High Polymers, a stage perhaps has been reached, where no new plastic material of spectacular properties could be discovered. But from the point of view of fundamental investigation into the nature and behaviour of High Polymers, as research in this field advances, greater is our perplexity, and in the words of the author, "the number of problems in the solution of which biology and chemistry of high polymers must join forces is infinite; wherever there is life, there is struc-

ture, a structure built up from high polymeric molecules".

Perhaps a short chapter on the mechanical behaviour of high polymers would have been welcome, but the author has taken care to refer to mechanical behaviours wherever found necessary in the body of the book. The book is admirably written and is indispensable to any scientific library. To the polymer chemist and biologist, it should be a fine reference book and the reviewer has no hesitation in recommending the book to investigators in the high polymer field. The book is admirably got up without any noticeable blemish. On page 683, instead of "see fig. 4, page 79", read "see fig. 4, page 19". A couple of very minor typographic errors are noticed on pages 265 and 822. The book is well indexed.

M. S. MUTHANA.

Electrical Engineering Design Manual: By S. Parker Smith and M. G. Say. Second Edition. Revised. (Chapman & Hall, Ltd.), 1950. Price 16 s. net.

This book is written by two Professors with long experience in the teaching of electrical engineering design.

In Part I of this book, the subject-matter is arranged in such a way as to give the student of design a knowledge of the basic principles underlying the design, such as: the laws of electric and magnetic circuits, the theory of armature windings, the equivalent circuits of electrical machines and also the economic and other reasons that have led to the adoption of present-day methods. From this point of view the chapter on Specifications is very useful. Chapter III on Heating, Cooling and Ventilation, similarly, deals with the factors that enter into the calculation of heat-flow and temperature-rise in electrical machinery.

The book does not purport to set out completely the procedure for designing transformers, generators, motors and other machines. Its primary object is to show how important data may be obtained from the underlying physical principles rather than by empirical methods. Adequate use is made of worked examples to illustrate the methods. The references indicated at the end of the chapters are all standard books of electrical design.

Part II of the book discusses in brief the speed-time curves and the nature of industrial drives. The discussion is rather general, probably due to space-restrictions. References are wanting. Perhaps the authors' idea is that the teaching staff will amplify the material and

guide the interested student further in the subject.

As the authors have stated in the Preface, the material of the book is intended for students rather than for designers. It needs a teacher to clarify and amplify many of the finer points of electrical design. But it is evident that the authors have taken great pains to present their ideas clearly and cogently. Their impact on students of electrical design cannot fail to have beneficial results. We extend to this new book in the field of electrical design a very hearty welcome.

H. V. GOPALAKRISHNA.

Wave Motion and Sound. By R. W. B. Stephens and A. E. Bate. (Edwin Arnold & Co., London). Pp. 445 + vi. Price 45 sh. net.

In most of our Universities, sound has become a Cinderella subject. The reason obviously lies in the nature of the subject itself. To some teachers, it is nothing but a collection of mathematical exercises. To a few others much less mathematically inclined, the experimental aspects have a powerful appeal. It is only the gifted teacher who can present the proper perspective of the subject, emphasizing its vital connections with the other branches of physics and holding the proper balance between theory and practice.

It is therefore not an easy job to write a text-book on sound. Even in standard text-books, the modes of approach may be seen to be greatly different. It is therefore not surprising that in the book under review, the presentation is on a new basis. Emphasis is laid on the theory of vibrations and attention is drawn to the consequent links with light, heat and electricity.

The book contains sixteen chapters, of which seven deal essentially with wave motion. The other nine are devoted to the remaining aspects of the subject. The chapters on architectural acoustics, on electrical, mechanical and acoustical analogies and on ultrasonics are of special interest, since they present much up-to-date information.

There are thirty mathematical appendices running over 75 pages. These are intended to meet the special requirements of the honours students. While these appendices are of great value, the reviewer feels that they could have been included in the body of the book at the appropriate places. The student will then be able to appreciate their significance and connection with the text to a better extent.

The authors have given a set of 94 useful examples at the end of the book. These are carefully chosen to test how far the student has appreciated the fundamentals of the subject.

The book is sure to be appreciated by students and teachers of acoustics. S. R. R.

The Nature of the Universe. By Fred Hoyle. (Basil Blackwell, Oxford), 1950. Pp. 121. Price 5 sh. net.

This is an eminently readable book. Its purpose is to present to the lay reader the essentials of modern cosmology. The material was originally broadcast and the lectures then delivered are here published without any change.

There are five chapters. The first gives an account of the earth and its immediate neighbours. The origin of stellar energy is considered in the next chapter and a brief account is given of the nuclear processes that account for such large and continuous emissions of energy. The origin and evolution of the stars are then set forth. Detailed pictures are given of the birth and death of the sun and of the methods for finding the ages of stars. Investigations show that our galaxy is still in its early youth (four thousand million years old) and is really a scene of intense and ceaseless activity. The earth itself is younger, but not very much younger, than the stars of our galaxy. Details relating to the origin of the earth and the other solar planets and the possibilities of life in other planets make interesting reading. The last chapter draws attention to the presence of vast numbers of other galaxies in the Universe similar to our own galaxy.

The picture of the new cosmology has been built together into a cogent whole by the aid of modern science. There are no doubt several lacunæ in the structure. The impact of philosophy on these concepts is still obscure. Whether the Universe as conceived by modern science will stand the test of time is an open question. But none can deny that the picture as it stands today is the outcome of a wonderful co-operative spirit and constitutes a tribute to the intelligence of man.

The book is sure to interest the layman and the specialist alike. S. R. R.

The Structure and Mechanical Properties of Metals. By Dr. Bruce Chalmers. (Chapman & Hall, London), 1951. Pp. 132 + ix. Price 18s. net.

This monograph, the second of a series published under the ægis of the Royal Aeronauti-

cal Society, by an authority in the field of Physical Metallurgy, will be read with interest and profit by all metallurgical engineers. Without resorting to advanced mathematical considerations, Dr. Chalmers has given a simple and comprehensive picture of the structure of metals and alloys and of the relationship between structure and ultimate mechanical properties. Dendritic and eutectic solidification, formation and structure of intermetallic compounds, slip on dislocation theory and fundamental concepts regarding mechanical properties are some of the topics dealt with in the monograph.

The treatment is throughout clear, brief and authoritative. The copious illustrations are very helpful and informative. The curves relating the tensile strength and other mechanical properties with grain size, extent of cold work, proportion of allowing elements, plastic strain, etc., appearing in the last chapter will be of particular interest to engineers. The lack of bibliographies is not so serious, because the text is highly condensed and gives the generally accepted views; besides, as stated by the author, this is not a reference book.

In spite of the excellence of the paper, printing and get-up, the price (18 sh.) of the monograph is rather prohibitive.

E. G. R.

Aerials for Centimetre Wavelengths (Modern Radio Technique Series). By D. W. Fry and F. K. Goward. (Cambridge University Press). Pp. 172 + x. Figs. 65. Price 18 sh.

With the vast developments in the microwave technique and the consequent application in the fields of Radar and Radio Communication, a great need has been felt for a book dealing with the subject of microwave aerials in a simple but comprehensive manner. The authors of *Aerials for Centimetre Wavelengths* seem to have this point in view, and they have really succeeded in the difficult task of giving a very lucid and comprehensive treatment of this subject without recourse to mathematics. The vast developments in microwave aerial technique at the Telecommunications Research Establishment, with which the authors were associated, are dealt with in detail in this book.

The text deals in the first chapter with the general requirements of centimetre aerials. The primary radiators such as dipoles and open ended waveguides and the secondary radiators such as reflectors, lens and horns are described very well in the fourth, fifth, sixth and seven

chapters. The subject of scanning has received its due share of importance in the text. The several methods of scanning and their relative merits and suitability of application for any particular case are very well discussed. The close analogy between the centimetric work and optical theory is very well brought out in the chapter dealing with the dielectric and the metal plate type of lens.

The several references in the text and the bibliography in the end are very useful to those wishing to refer to the original papers. Printing and production are both excellent. The book can very well be recommended for the use of the research worker as well as the practical engineer in this field.

V. N. R.

First Year Calculus. By M. N. Bhat. (The Educational Publishing Co., Bombay 4), 1950. Pp. 190. Price Rs. 3.

This is a text-book for the first year course of the Poona University, covering also more than half of the Intermediate syllabuses of some other universities. Since it is intended for beginners, the treatment is mainly descriptive and elementary, though vigour has been introduced wherever necessary. The concepts of limit and differentiation have been very clearly presented in three chapters. The following two chapters are devoted to physical and geometrical applications, and the last two, for integration.

Every chapter contains a number of exercises and illustrative examples. The book could have been made more interesting to students above the average by the addition of some topics even outside the syllabus, like applications of differentiation of function of a function, angle of intersection of two curves, differentiation of higher orders and some advanced examples.

One outstanding defect is that the sign of the differential coefficient of inverse sine and cosine functions is left ambiguous.

On the whole it is a well-written book and it is sure to serve the purpose for which it is intended.

S. N. M.

Commercial Methods of Testing Milk and Milk Products. By J. Lyons and M. J. O'Shea. (Cork University Press, Ireland), 1950. Pp. 218; Illustrations 55; Price 15 s.

This book containing the elements of routine methods of quality control of milk and milk products has been prepared by the authors keeping in view chiefly the needs of the "dairy

students and persons engaged on the technical side of dairying", and makes no attempt to discuss the methods in detail or the principles underlying them, presumably to prevent the technician from being unduly confused.

A major part of the book is devoted to the determination of butterfat in milk and milk products and methods are presented and illustrated with examples for the rough calculations of yields of milk products from milk. Methods for the determination of total solids, solids not fat, and acidity in milk and milk products as also for the determination of water, salt and curd in butter and for the detection of adulterated milk have been described. A number of platform and routine tests have been grouped under 'tests for sanitary quality of milk', and under 'other useful tests in the dairy', and are intended to be useful in meeting a wide variety of situations arising in the dairy technician's schedule of work. Two Appendices to the book—one containing information, such as weight and measure conversion tables, price conversion tables, etc., and another containing questions on the contents of each chapter in the book add to the value of the book. Very few misprints occur, but on p. 27 listing enzymes of milk, Reductase has been described as an enzyme of bacterial origin which "reduces methylene blue, and gives, by the time required for reduction, an indication of bacterial content". This statement is incorrect in the light of present knowledge, since it is now accepted on all hands that the reduction of methylene blue to its leuco base is due to the oxygen uptake by bacterial cells rather than to the elaboration of any enzyme.

The book is written in a simple and lucid style and should prove useful to all those connected with routine examination of milk and milk products as well as to students of dairying. The get-up and printing of the book are excellent.

K. K. IYA.

A Century of Soil Science in Indonesia. By F. A. Van Baren. *O.S.R. Publication* 24. (Published by H. Van Ingen, Surabaya).

This is a communication from the Section of Mineralogy and Agreology, Faculty of Agricul-

tural Science, University of Indonesia, Bogor, and consists of an introduction, two sections and a table of reference. In the introduction, the author states very truly that 'the history of many parts of the world teaches that, whenever the soil as a producing substratum deteriorates and becomes removed, every civilization inevitably disappears'.

In the first section, the development of interest in and understanding of the problems of soil fertility are dealt with. The scientific study of soil either for its own sake (Pedology) or in its applied form is of very recent origin not more than three hundred years at the utmost. In 1852, the first experimental plots were laid out in Buitenzorg, Java, by Dr. Fromberg and from that time on to date there has been a steady development of the study of soils of Indonesia, broken only by the years of Japanese occupation during World War II. Interest in coffee, tobacco and sugarcane soils started early and by 1873, it had extended to rubber, paddy and fish culture. A series of summarizations of important works contributed by workers follows in which practically every aspect of soil science, pure and applied, seems to have been tried.

In section two, which deals with Soil Conservation, is reviewed in a very brief and precise manner the attempts made not only to restore the fertility of the soils which had lost it by bad management, but also those made to maintain and improve soil fertility at a very high level. Most soil erosion control measures known to people all over the world appear to have been tried and often with great success. To conclude, the author is of the opinion that 'the fight against soil devastation is a task of the Government itself and has to be founded in regulations having the force of law'. The culmination of the hundred years of Soil Science is to be found in the establishment in 1947 of a Bureau of Land Use incorporated in the Forest Service. An excellent list of 94 references follows. The report is very readable, and one ends up with an ever-increasing admiration for the investigators of the past 100 years in Indonesia for their foresight, industry and courage in breaking out into new lines of work.

N. G. C.

SCIENCE NOTES AND NEWS

University of Madras: Award of Prizes

"THE MAHARAJA OF TRAVANCORE-CURZON PRIZES" for 1951-52.—Two prizes, one in each of the following groups of subjects, will be awarded by the Syndicate for the best essay or thesis written by any Graduate of the Madras University on any topic dealing with one of the subjects mentioned below:

D	E
Archæology	Pharmacology
Anthropology	Pathology
	Bacteriology

The value of each prize is Rs. 250.

The prize will not be awarded to the same applicant on a second occasion.

Theses should reach the Registrar not later than the 1st March 1952.

"SIR WILLIAM WEDDERBURN PRIZE, 1952".—The prize, which will consist of books of the value of Rs. 45, will be awarded to the student, who is qualified in Chemistry for the Degree of B.Sc. (Honours) or M.Sc. not more than two years previously. A thesis on any research work conducted by the student should be submitted with the application.

The work submitted should not have formed the basis of a work for which any prize or a degree had been previously awarded, and should reach the Registrar not later than 30th April 1952.

Indo-Pacific Fisheries Council--Third Meeting

The Third Annual Meeting of the I.P.F.C. was held at Madras from February 1st to February 16th and was attended by Representatives of the Governments of Australia, Cambodia, Ceylon, France, India, Indonesia, Netherlands, Pakistan, Philippines, Thailand, United Kingdom, U.S.A. and Vietnam. The following international organizations were represented by Observers: FAO, PSC, SCAP, SPC, UNESCO.

The Council laid down a detailed plan of work in connection with the preparation of fishery bibliographies and a series of fishery handbooks. Recommendations were made for action to secure the widest possible dissemination within the region of information concerning fishery matters and also for the use of documentary films on fishery subject. The Council paid particular attention to the problem

of providing trained personnel for the fishing industries of the region and adopted a plan for the development of projects for technical instruction.

A Simple Suction Pump

Sri. P. Kachroo, of the Botany Department, Gauhati University, writes:

The following modification of the common bicycle pump has been of great utility in my botanical trips to the hills for exhausting air from thallose liverworts, fern prothalli and flower buds. The modification consists in reversing the washer, and using a rubber cork of required dimensions with a solitary bore at the end of the rubber tubing leading to the pump, thus converting it into a suction pump. Pumping for 10-15 minutes 3 or 4 times during 24 hours is sufficient to sink the material, but care should be taken not to exhaust all the air at once, lest the material may collapse due to plasmolysis.

Dr. Inderjit Singh

A Travelling Fellowship has been awarded by the World Health Organisation to Dr. Inderjit Singh to visit U.S.A., U.K., Sweden and Switzerland. During his tour he will work at the Laboratory of Physiology, Yale University.

Diamond Tool Industry in 1950

As in previous years the Industrial Diamond Information Bureau, London, E.C. 1, has compiled a survey of the Diamond Tool Industry in 1950, utilising the main sources of supply of this literature. This year's report is subdivided into the following groups: Scientific Aspects, Diamond Radiation Counters, Ruling Diffraction Gratings, Gramophone Needles, Surface Finish, Hardness Testing, Shaped Diamond Tools, Truing of Grinding Wheels, Diamond Drawing Dies, Diamond Powder, Diamond Grinding Wheels, Glass and Quartz, Gemstone Polishing, Corundum, Diamond Drilling. Copies of this publication (11 pages mimeographed) can be obtained free of charge from the above address while the supply lasts.

Purchase of Scientific Materials and Films

The Government of India have agreed to allow import without a licence of certain items

of scientific materials (list circulated with Occasional Bulletin No. 24) and scientific films, ordered with the UNESCO Scientific Material Coupons and UNESCO Film Coupons. These coupons are on sale from the Ministry of Education, Government of India, New Delhi. The UNESCO Office at Delhi has also a supplementary stock of these two types of coupons. These coupons are usable like the UNESCO Book Coupons, orders to be placed with the manufacturers and distributors participating in the scheme.

German Research in Engineering and Metallurgy

Results of research sponsored by D.S.I.R. in Germany after the war are now available as Reports issued under the title "Sponsored Research (Germany)". The Reports now ready are of importance mainly to designers and users of gear-wheels, though metallurgists will find some of interest. These Reports are available to Industrial Research Departments, Universities and individual research workers and can be obtained only from the D.S.I.R., 5-11, Regent Street, London, S.W. 1.

New Journal for Experimental Parasitology

Experimental Parasitology, a new quarterly journal, will be launched in the summer of 1951. Dr. D. R. Lincicome, Stine Laboratories, Newark, Delaware, has assumed the duties of the Managing Editor and will be assisted by an Editorial Board composed of Drs. H. H. Anderson, T. von Brand, E. Bueding, A. C. Chandler, E. C. Faust, Q. M. Geiman, G. van Grembergen, C. G. Huff, A. Lwoff, J. Oliver-Gonzalez, C. B. Philip, W. P. Rogers, J. D. Smyth, and N. R. Stoll.

Original papers dealing with experimental approaches to problems in the field of parasitology will be eligible for editorial consideration; contributions that involve experimental physiological, metabolic, biochemical, nutritional and chemotherapeutic problems of parasites and host-parasite relationships are especially desirable. In addition to original research material a section of the periodical will be devoted to "Parasitological Reviews", covering all aspects of the field. These Reviews will be prepared upon the invitation of the editors.

Manuscripts may be submitted to the Managing Editor or to any Member of the Board of Editors. *Experimental Parasitology* will be published by Academic Press Inc., New York 10, N.Y.

Nuclear Power Plant

Sir John Crockcroft, Director of Britain's Atomic Energy Research Establishment at Harwell, observed in a lecture recently: "We are working on the development of an experimental nuclear power plant. This will consist of a pile operating at a temperature of perhaps up to 600 degrees Centigrade. This heat will be transferred to a steam boiler and the steam raised will be used to generate power in the conventional way."

Nuffield Foundation Travelling Fellowships, 1951-52

The Nuffield Foundation Indian Advisory Committee consisting of Mr. G. L. Mehta (*Chairman*), Sir C. V. Raman and Sir J. J. Ghandy (*Members*), assisted by a few specialists, have selected five candidates, two for medical sciences, one for engineering, one for plant genetics and one for industrial relation and personnel management, whose names would be recommended to the Nuffield Foundation for the award of the Travelling Fellowships. The selected candidates will hear from the Nuffield Foundation by June 1951, regarding the centres in the U.K. where they would be offered the necessary facilities for carrying out their programme of work. The Indian Advisory Committee have also finalised its recommendations to the Nuffield Foundation regarding the subjects for the award of Travelling Fellowships for 1952-53 and the names of persons in the U.K. who should be invited to India as Visiting Professors during this year.

Forthcoming Symposia at the National Chemical Laboratory, Poona

Date	Subject	Organiser
May 4, 1951	Rubber and Rubber Waste	Dr. J. B. Pande
June 8	Organic Fine Chemicals and Industry	Dr. R. C. Shah
July 6	Chemicals for Agriculture	Dr. M. U. Pai & Dr. C. K. N. Nair
August 10	Chromatography	Dr. J. Gupta
Sept. 11-14	Vegetable Oils and Their Utilisation	Dr. J. S. Agarwal

ERRATUM

VOL. 20, No. 3, MARCH 1951, PAGE 66

In the letter to the Editor, "On Thickness Lines in Relation to the Onset and Movement of Cold Waves in Western Pakistan and Northern and Central India during Winter"—

Column 1, last line:

"12° N." should read as "21° N."

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THE INSTITUTION OF CHEMICAL ENGINEERS

27TH ASSOCIATE MEMBERSHIP EXAMINATION

Application forms (returnable 1st June 1951) and particulars of the 27th Associate Membership Examination may be obtained from the Hon. Registrar, Institution of Chemical Engineers, 56, Victoria Street, Westminster, London, S.W.-1.

Note.—Written and oral examinations will be held in September 1951. Home Papers will be issued in January 1952. Provided intimation is received before 1st June at the Institution offices that the fee and formal application form have been sent, applications will be accepted up to the 30th June, 1951.

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CONTACT THERMOMETERS with fixed or variable contact.

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CAUSALITY AND COMPLEMENTARITY*

NIELS BOHR

IN physics, causal description, originally adapted to the problems of mechanics, rests on the assumption that the knowledge of the state of a material system at a given time permits the prediction of its states at any subsequent time. However, a wholly new situation was created through the discovery of the universal quantum of action, which revealed an elementary feature of individuality of atomic processes far beyond the old doctrine of the limited divisibility of matter originally introduced as a foundation for a causal explanation of the specific properties of material substances. This novel feature is not only entirely foreign to the classical theories of mechanics and electro-magnetism, but is even irreconcilable with the idea of causality.

The very fact that quantum phenomena cannot be analysed on classical lines thus implies the impossibility of separating the behaviour of atomic objects from the interaction of these objects with the measuring instruments which

serve to specify the conditions under which the phenomena appear. In this situation, an inherent element of ambiguity is involved in assigning conventional physical attributes to atomic objects. A clear example of such an ambiguity is offered by the dilemma concerning the corpuscular and wave properties of electrons or photons, where we are faced with the contrast revealed by the comparison between observations regarding an atomic object, obtained by means of different experimental arrangements. Such empirical evidence exhibits a novel type of relationship, which has no analogue in classical physics and which may conveniently be termed *complementarity*, in order to stress the fact that, in the contrasting phenomena, we have to do with two equally essential aspects of all well-defined knowledge about the objects. It is this complementarity which appears as a rational generalisation of the notion of causality.

The epistemological lesson we have received from the new development in physical science, where the problems enable a comparatively

* Abstracted from *Science*, 1950, 111, 51.

concise formulation of principles, may also suggest lines of approach in other domains of knowledge where the situation is of an essentially less accessible character. An example is offered in biology, where mechanistic and vitalistic arguments are used in a typically complementary manner. In sociology too, such dialectics may often be useful, particularly in problems confronting us in the study and comparison of human cultures, where we have to cope with the element of complacency inherent in every national culture manifesting itself in prejudices which obviously cannot be appreciated from the standpoint of other nations.

Recognition of complementary relationship is not less required in psychology, where the conditions for analysis and synthesis of experience exhibits striking analogy with the situation in atomic physics. In particular, the place left for the feeling of volition is afforded by the very circumstance that situations where we

experience freedom of will are incompatible with psychological situations where causal analysis is reasonably attempted. In other words, when we use the phrase "I will", we renounce explanatory argumentation.

Altogether, the approach towards the problem of explanation that is embodied in the notion of complementarity suggests itself in our position as conscious beings, and recalls forcefully the teaching of ancient thinkers that, in the search for a harmonious attitude towards life, it must never be forgotten that we ourselves are both actors and spectators in the drama of existence. To such an utterance applies, of course, the recognition that our task can only be to aim at communicating experiences and views to others by means of language, in which the practical use of every word stands in a complementary relation to attempts at its strict definition.

CENTRAL DRUG RESEARCH INSTITUTE, LUCKNOW

THE Central Drug Research Institute, Lucknow, which was declared open by the Prime Minister, the Hon'ble Pandit Jawaharlal Nehru, on February 17, has for its functions the following:

- (1) Promotion of drug research in general.
- (2) Testing and standardizing drugs discovered in the Institute and providing expert advice for the further development and production of these drugs.
- (3) To offer facilities and advice to scientists, universities, appropriate institutions, industries and others who may not be in a position to carry out or complete investigations on matters relating to drugs.
- (4) To organise controlled clinical trials of drugs in hospitals and clinics.

- (5) Dissemination of scientific knowledge relating to drugs.

The Institute will have the following divisions to begin with: (1) Chemistry; (2) Biochemistry; (3) Pharmacology; (4) Microbiology and Parasitology and (5) Clinical Science.

A sixth Division of Botany including Pharmacognosy is also likely to be included in the near future. In addition to these Scientific Divisions, there will be an Animal House, an Intelligence and Statistical Section including a Central Library, a Workshop for the fabrication of instruments, special glass apparatus and small type of pilot plants, a Construction and Maintenance Section, and a Museum.

From its inception, the Institute has had the advantage of the guidance of Col. R. N. Chopra, the pioneer of drug research in India.

INTERNATIONAL COMMISSION FOR PLANT SLIDE EXCHANGES

THE aim of the Commission is to enable co-operating institutions and individuals to build up reference slide collections by exchanging plant materials sent in by them for slides processed from either these materials or from those forwarded by others. Any individual botanist, department of botany or botanical institution may become a member of the Commission upon payment in advance of an annual fee of ten dollars (\$10.00, U.S. Currency). Fees will be used solely for overhead expenses such as the preparation of lists of slides, slide boxes, postage, clerical assistance, etc. Members are ex-

pected to collect and fix properly for slide-making purposes plant materials indigenous to their respective regions or collected elsewhere by themselves. All plants from the algæ on are to be included, as are all plant structures. The two standard microtechnique manuals should be used for guidance in collecting: Johansen, *Plant Microtechnique*, and Sass, *Elements of Botanical Microtechnique*. Any further information can be obtained from: Dr. D. A. Johansen, Chairman, International Commission for Plant Slide Exchanges, 861, East Columbia Avenue, Pomona, California, U.S.A.

SOME OBSERVATIONS ON THE STRUCTURE AND CLASSIFICATION OF THE DHARWARS OF MYSORE STATE

C. S. PICHAMUTHU

(Director, Mysore Geological Department, Bangalore)

THE Dharwar Schists in Mysore have so far been considered as occurring in a few isolated well-defined bands. The earlier geologists described them under three separate units, the Shimoga belt, the Chitaldrug belt, and the Kolar belt. Rama Rao¹ further subdivided the first two belts according to their regional distribution and made the following five-fold grouping of the Dharwars of Mysore: (i) *Western* (Kodachadri, Agumbhe and Kuduremukha regions); (ii) *West Central* (Shimoga, Bababudan, Holenarsipur and Krishnarajpet regions); (iii) *Central* (Chitaldrug, Chiknaikanhalli and Nagamangala regions); (iv) *East Central* (Scattered stringers); (v) *Eastern* (Kolar region).

Such a geographical grouping has, of course, certain advantages for descriptive purposes, but this has tended to give unnecessary individuality to each of these belts, and even the proposed systems of classification of the Mysore Dharwars have been somewhat influenced by this regional consideration.

The main reason for the lack of progress in our knowledge of the detailed stratigraphy and tectonics of the Dharwars of Mysore was due to the belief held till recently that their constituent members were igneous in origin. Several of the earlier geologists have often referred in their writings to folds such as anticlines and synclines, but no area was worked out in any detail from the structural point of view, nor was the succession of beds determined. The geological map of Mysore on a scale of 8 miles to an inch which was published in 1915 under the direction of Dr. W. F. Smeeth is a valuable record of the mapping done so far, and though later work has shown that in some cases the boundaries require alteration, and the interpretation of rock types some modification, the main features can be taken as reasonably accurate. A study of this map shows that the Dharwar rocks especially in the northern half of the State have sinuous outcrops and have the appearance of festoons, a fact which indicates that the beds have been thrown into a series of folds.

One of the folds in the Dharwar rocks in the southern portion of the Chitaldrug Schist belt near Dodguni was recently studied in some detail.² It was seen that the component beds of the Dharwar Schists here are folded such

that they generally dip away from the fold-axis. In the western limb of the fold the beds have a steep westerly dip, and the evidence of current bedding in the quartzites indicates that the beds in this limb young westwards. Similar observations made in the eastern limb of the fold showed that the rocks uniformly dip east and young eastwards. As the result of the use of this technique, it was found that the beds here are normal and not reversed, and that the nature of the fold is a true anticline. The noses of the beds are towards the north, a feature characteristic of a plunging fold. The pitch in this case was found to be in a north-north-west direction. The Dodguni fold is, therefore, a pitching anticline which closes northwards.

From the geological map of Mysore, it is seen that the folds closing southwards are pitching synclines. Two good illustrations are found—one north of the Sulekere tank in the Shimoga Schist belt, and the other south of Jogimardi in the Chitaldrug Schist belt.³

Banded ferruginous quartzite is a very characteristic component of the Dharwar System. Its resistance to erosion has proved invaluable in emphasising the structural pattern of the Dharwar rocks. There is one prominent ferruginous quartzite zone in Mysore which is also manganese-bearing and is associated very often with limestones. This is shown in the accompanying sketch map. Almost all the important manganese mines of the State are situated on this. In the writer's opinion, this zone should be of considerable value in the proper interpretation of the structure and classification of Mysore Dharwars.

This zone commences in the Western Ghats and after undergoing a few crumples near Kuduremukha and Mertiparvata, stretches practically due north through Shankargudda and Kumsi. The trend becomes sinuous, because of folding, southeast of Shikarpur and near Hosur, and proceeds eastwards along the border of the State till it meets the river Tungabhadra. From west of Malebennur, it strikes southeast till it is sharply folded back near Sulekere as a pitching syncline. The right limb runs north towards Hadadi. The trail is lost here because of the intrusion of the Peninsular gneiss, but we can pick it up again southeast of Anaji. After a short break, and

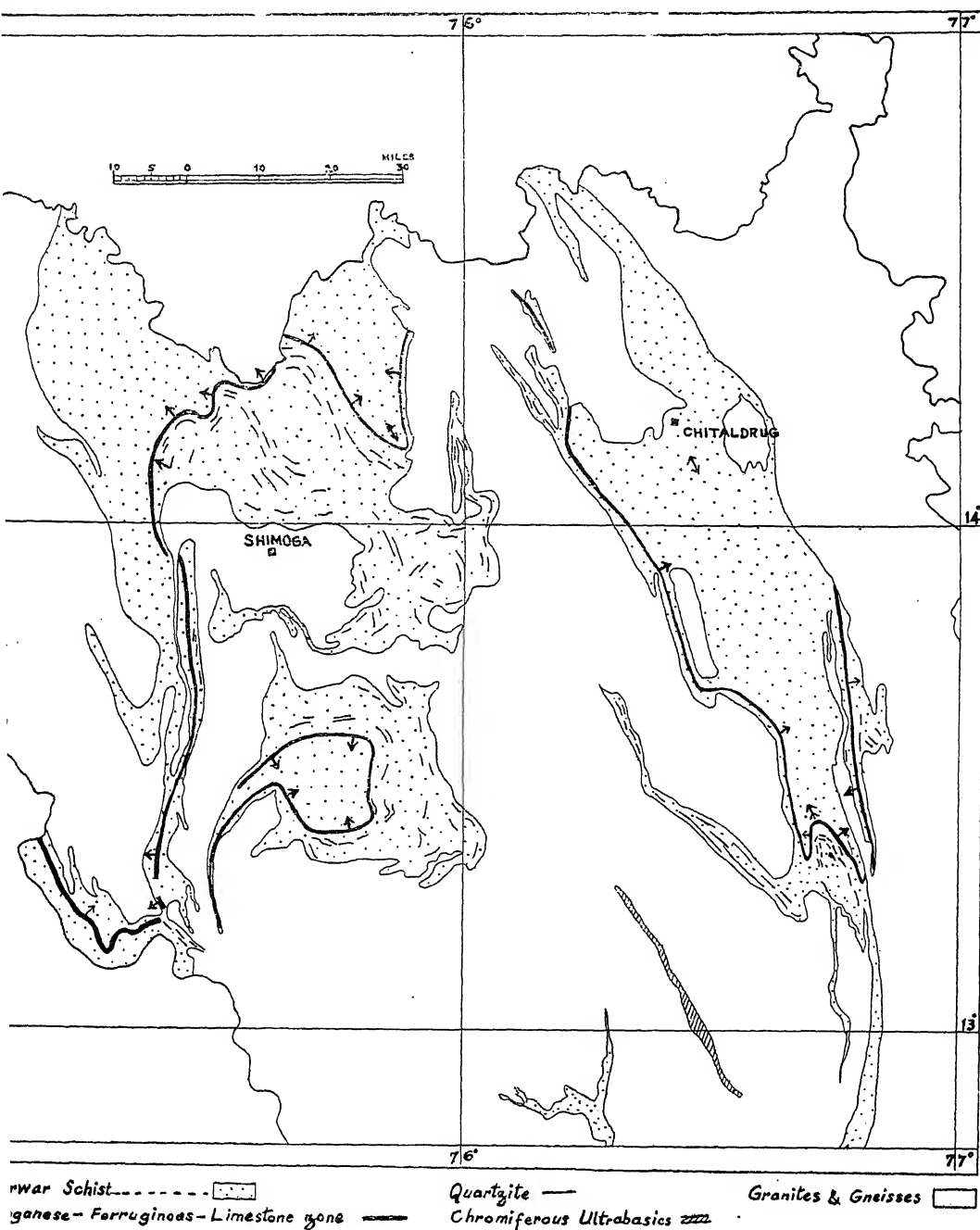


FIG. 1. Geological sketch map of the north-western part of Mysore State to illustrate the main structural features of the Dharwar Schists.

with probably a displacement due to faulting, the zone skirts the western margin of the greater portion of the Chitaldrug Schist belt, and passes through Shivgange, Madadkere, Mattod and Hatyal. At this place the zone is folded into the Dodguni pitching anticline, the right limb of which is sharply folded back. This continues almost due north to the east of Bukkapatna and disappears near Javagondanahalli.

The structure and disposition of this zone indicates that it is a huge anticlinorium with many minor anticlines and synclines, and having a general north-north-westerly pitch.

The Kolar Schist belt is comparatively a very small one and is too far removed from the other Schist belts of Mysore State to be of much use in the interpretation of the general structure of Mysore Dharwars. It is also separated from the other bands by the Closepet granites which runs right across the State in a north to south direction.

Attention will now be drawn to another very significant fact. A reference to the geological map of Mysore shows that numerous quartzite runs are found in the Schist outcrops below this prominent manganese-iron zone and none above it. The schist rocks near Kalasa, Mandagadde, Kumsi, Saulanga, Holalur, Joldhal, Hodigere, Tarikere, Chikmagalur, Chiknaikanahalli, Kondli, etc., are full of bands of quartzite of varying thickness and length. Many of them have well preserved ripple marks and current bedding.

On the other hand, quartzite runs are conspicuously absent in the area occupied by the Shimoga Schist belt towards the west of the Kumsi-Kalasa line. Similarly, the wide expanse of the Chitaldrug Schist belt east of the Anaji-Janehar line is devoid of quartzites. This fact should throw some light on the difficult problem of Dharwar classification.

The middle portion of this anticlinorium is extremely complicated. The Joldhal-Ubrani area is highly churned up and presents eddy structures of baffling complexity. The rock formations have been twisted and broken into small bits, so that they strike and dip in practically all directions of the compass.

Further south, the Bababudan area also presents some difficult tectonic problems. The iron formations occur in the shape of a horse-shoe with the opening on the north-west at Hebbe, but this opening is partially closed and gradually tapers towards the south. The iron for-

mations do not contain workable deposits of manganese, and the association of limestone can only be inferred by the presence now of rhombs pseudomorphous after some carbonate.⁴ Here again, the quartzites are found right round only on the outer margins of the hills⁵ whereas no runs occur within the horse-shoe in the Jagar valley. The connection between this ferruginous band and the Kumsi-Kalasa zone has been severed by the intrusion of Peninsular gneiss, and so the relationships are not quite clear.

South of the 13th parallel, the Dharwar Schists outcrop in isolated stringers, lenses, and patches. They also exhibit a higher degree of metamorphism and so the elucidation of structure and stratigraphy is rendered extremely difficult. Near Chattanahalli, Sargur and Kandalike, the occurrence of discontinuous runs of limestone and quartzite are the only indications of the southern continuation of the Schist belts. In the extreme south of the State the strike veers towards the west, till finally many of the outcrops have an east-west direction. The zone of mylonite mapped by Jayaram⁶ in the Kapini valley appears to demarcate the boundary between the two metamorphisms, one characterised by the NNW-SSE strike of rocks north-west of Heggaddevankote, and the other resulting in an almost E-W strike of rocks to the west and south of Sargur.

The workable deposits of chromite in Mysore occur only in a narrow band of ultrabasic rocks running in a north-west to south-east direction from Arsikere to beyond Nuggehalli, and again south of Mysore. It has always been difficult to explain this, but in the structure of the Dharwar schists proposed in this note, it is seen to occupy a central position in the anticlinorium. The chromiferous ultrabasic rock was probably intruded along the core or axial plane of this huge fold.

A new interpretation is offered in this paper regarding the geological structure of the Dharwar Schists of Mysore. It is hoped that this would throw further light on the problem of classification of these ancient rocks.

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EFFECT OF AMINOPTERIN ON THE UPTAKE OF RADIOACTIVE
PHOSPHORUS BY SOME ENDOCRINE TISSUES OF THE RAT

KUMUD D. SAMARTH, A. J. BAXI, B. R. BALIGA AND P. R. VENKATARAMAN

(Division of Laboratories, Tata Memorial Hospital, Bombay 12)

THE potent folic acid antagonists, aminopterin (4-amino folic acid) and amethopterin (4-amino-N¹⁰-methyl folic acid) are being extensively employed for the amelioration of certain types of leukemia and other neoplastic diseases.^{1,2} These antimetabolites induce a folic acid deficiency in the rat and other animals. The report of the deleterious effect of folic acid or pteroylglutamic acid (PGA) deficiency on the body growth has led to the question of the mechanism involved. Hertz³⁻⁶ has shown that the oviducts of PGA deficient chicks respond less readily to the effects of estrogen than those of normal or PGA treated chicks. This effect was not shown in other B-vitamin deficiencies. Marvin, Totter and Day⁷ have studied the effects of PGA deficiency and PGA replacement on the endocrine glands of the immature chick. Their observations appear to show a primary disturbance involving diminished pituitary activity, retardation of thyroid development and hyperplasia of the tubules of the testes. Since endocrine substances and vitamins often affect the same physiological processes either in the same direction or antagonistically, it became of interest to study the uptake of radioactive phosphorus (P³²) by some of the endocrine tissues of the rat after treatment with aminopterin.

Inbred Wistar strain male rats, weighing between 180-250 gm., raised on our standard laboratory ration, were used. One group of rats received aminopterin at a level of 0.23 mg. per kg. for seven days. No treatment was given on the eighth day. After fasting for 14 hours, the animals received aminopterin at a level of 8.33 mg. per kg. on the morning of the ninth day. This was immediately followed by intraperitoneal administration of radioactive* disodium phosphate in normal saline. The total amount of phosphate administered was physiologically negligible, being less than 0.2 mg. The animals were sacrificed after two hours and the tissues were removed, weighed on a Roller-Smith torsion balance and digested. The animals of the control group were treated in the same way except that in the place of aminopterin, they received corresponding volumes of normal saline. A third group of

animals fasted for 14 hours, received a single massive dose of aminopterin at a level of 8.33 mg. per kg. immediately prior to the administration of radioactive phosphorus. All groups of animals were sacrificed two hours after the administration of the labelled phosphate. The tissues were digested at 120° C. in an oven for several hours with sulphuric acid followed by frequent addition of concentrated nitric acid. The clear digest was diluted with water and hydrolysed at 100° C. for 15 minutes. The orthophosphate was precipitated as the magnesium-ammonium complex by the method of Sacks and Sacks as described by Cori and Cori.⁸ The precipitates were collected at the centrifuge, washed twice with 2.5 ml. of 2.5 per cent. ammonia and dried in an air oven at 100° C. They were brought into solution in a suitable volume of 5 per cent. hydrochloric acid. Aliquots were plated⁹ out on stainless steel cups, 2 × 0.4 cm., and dried in an air oven at about 60° C. Measurements of radioactivity on the dry samples were made with G.M. 4 Geiger counter tubes (General Electric Co., Ltd.) and a scaling unit, type SC-200 (Dynatron Radio Ltd.). All samples were placed in the lead castle at the same distance from the counter. The results, average of 4 animals from each group, are presented in the table given below:

Effect of Aminopterin on the Uptake of P³² by the Endocrine Tissues of the Rat

	Testes		Thymus		Thyroid		Adrenal	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Control	2.3	1.4	23.8	11.8	14.1	7.0	16.3	8.4
Cumulative dose	2.1	1.0	22.9	11.6	30.3	14.2	8.0	3.8
Single dose	2.1	0.9	25.2	10.8	25.2	11.0	25.6	11.1

Aminopterin and normal saline were injected subcutaneously. All animals received 50 μ c of P³² intraperitoneally. The results are expressed:

- (a) $\frac{\text{Cpm. per g tissue}}{\text{Cpm. administered per gm. body weight}} \times 10$,
 (b) Cpm. per gm. tissue as parts per thousand of the dose administered.

No data or observations are presented with regard to the uptake of P³² by the pituitary. Aminopterin seems to have no influence on the

* Obtained through the kindness of the Isotopes Division, A.E.R.E., Harwell, England,

uptake of P^{32} by the testes. Probably this finding offers an indirect support to the observations of Goldin and co-workers¹⁰ on the inability of testosterone propionate to reverse the toxicity of aminopterin in mature male mice. Although Higgins¹¹ has observed the atrophy of the thymus following the treatment with aminopterin, no significant differences in the uptake of radioactive phosphorus could be found. Of the endocrine tissue studied, adrenal and thyroid need special comment. Higgins¹¹ has also observed hypertrophy of the adrenal glands after treatment with aminopterin. A single massive dose of the antimetabolite just two hours prior to the sacrifice increases the uptake of P^{32} significantly over the control. This would indicate an heightened metabolic activity of the secretory tissue. The uptake of P^{32} by the adrenals of rats which have received cumulative dose is considerably lower compared to the normal. Probably, in these animals with the development of more secretory units of the adrenals, the rate of metabolic activity is diminished. A single dose of aminopterin markedly raises P^{32} uptake by the thyroid gland indicating an increased metabolic activity of the gland. In animals which have received cumulative dose of the antimetabolite, the uptake is slightly higher compared to the animals which have received a single dose. It appears that aminopterin enhances the metabolic activity of the thyroid gland probably through the pituitary or the adrenal. The above observations on the uptake of P^{32} by the adrenal and the thyroid under the influence of aminopterin, seem to substantiate the observations of other workers¹²⁻¹⁴ on the interrelationship between the functional activity of the adrenal cortex and thyroid secretory levels under totally different conditions.

The effect of aminopterin on the uptake of P^{32} by the adrenals cannot be wholly explained

on the basis of a "stress" reaction, in view of two other important observations, however indirect they may be. The first relates to the elimination of the differential sex toxicity in mice¹⁰ to the antifolic acid compound after adrenalectomy. Secondly,¹⁵ patients treated for metastatic cancer with aminopterin, show a unique reduction in the excretion of reducing corticoids (11-oxysteroids) with no parallel change in the excretion of 17-ketosteroids. Under conditions of "stress" the excretion of reducing corticoids (11-oxysteroids) is generally found to be increased together with 17-ketosteroids.

We are thankful to Dr. A. R. Gopal-Ayengar, Chief Research Cytologist, for his kind help and interest in this investigation. We are indebted to Lederle Laboratories (India) Ltd., for a generous gift of aminopterin required in this work. This investigation is aided by grants from the Atomic Energy Commission of the Government of India.

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UNESCO AND TECHNICAL ASSISTANCE TO INDIA

ACCORDING to a recent agreement between the UNESCO and the Government of India, the UNESCO will provide 10 specialists to work in India, two of whom would work in the National Laboratories (Physical and Chemical), three in the Indian Institute of Technology, Kharagpur, three in the Research Laboratories of the Central Water-power, Irrigation and Navigation Commission, and one each in the Birbal Sahni Institute of Palaeobotany, Lucknow, and the Central Institute of Education, Delhi.

Technical and other equipment to the extent of \$22,000 will be supplied by UNESCO. In addition, the UNESCO has agreed to consider requests for additional essential equipment required for the work of specialists. The UNESCO has also agreed to award fellowships and study grants to the extent of \$22,000 to selected Indians who would eventually replace these specialists.

Proposals in regard to the establishment of a Scientific Bibliographical Centre in India are under consideration of the Government of India and the UNESCO.

STUDIES ON THE INTER-RELATIONSHIP AMONG VITAMINS AND AMINO-ACIDS

Influence of Desoxy-pyridoxine on the Bio-synthesis of Nicotinic and Ascorbic Acids in Germinating Pulses

E. R. B. SHANMUGA SUNDARAM, G. RANGANATHAN AND P. S. SARMA

(Bio-Chemical Laboratory, University of Madras)

TRYPTOPHANE-NICOTINIC acid interrelationship first demonstrated with rats,^{1,2} has been extended to other mammals^{3,4,5} plants and micro-organisms, and such studies have been widened to include other vitamins and amino-acids. It has been shown for example that tryptophane serves as a niacin precursor in the case of the fungus *Neurospora* by way of kynurenine and 3-hydroxy anthranalic acid.^{6,7} Seeds are known to give rise to increased amounts of thiamine,⁸ nicotinic acid and riboflavin,⁹ pyridoxine,⁸ and ascorbic acid,¹⁰ during germination. But it was found that a tryptophane-niacin relationship did not exist in the case of bean seedlings grown without their cotyledons on synthetic media.¹¹ Nason¹² has, however, shown that a tryptophane-niacin relationship similar to that found in certain mammals and *Neurospora*, does exist in higher plants like the corn and has studied the effect of l-tryptophane and vitamin B₆, individually as well as in combination. He concluded that niacin synthesis is a direct function of the supply of l-tryptophane and is independent of the vitamin B₆ used, since addition of vitamin B₆ to the medium did not significantly increase niacin synthesis. Banerjee and Banerjee¹³ have shown that in the case of *Phaseolus mungo* addition of vitamin B₆ to the medium does not enhance the bio-synthesis of niacin. In the case of ascorbic acid, however, the effect of the addition of several nutrients during germination on the bio-synthesis of this vitamin has been studied.^{10,14,15,16} But there appears to be no general agreement on the specific constituents which promote such bio-syntheses. Thus, the beneficial influence of salts, of manganese and marmose have been shown by some, while others have not been able to confirm these observations. In the case of rat, some data of a controversial nature, as regards ascorbic acid content in various tissues have been obtained in 1939 by Sure and his associates.¹⁷ Studies have, therefore, been undertaken first with germinated seedlings with a view to elucidate these problems. Cereals and pulses contain appreciable amounts of vitamin B₆,^{18,19} which increases during germination.⁸ Any study of the influence of vitamin B₆ on the inter-relationship between tryptophane and nicotinic acid and on the bio-synthesis of ascorbic acid should therefore take into account the

initial presence of B₆ in the seed before germination. In order to counteract the influence of vitamin B₆ already present, a competitive inhibitor like desoxy-pyridoxine^{20,21} was added to the medium during germination. It was then found that the bio-synthesis of nicotinic and ascorbic acids could be greatly influenced by vitamin B₆ during the course of germination of several pulses.

EXPERIMENTAL

(a) *Germination.*—Green-gram (*Phaseolus mungo*), cow-pea (*Vigna sinensis*) and red-gram (*Cajanus cajan*) have been used in the course of these experiments. Seeds (5 gm. for nicotinic acid and 2 gm. for ascorbic acid) were sterilised with 0.1 per cent. mercuric chloride solution, washed and transferred into sterile petri-dishes containing a layer of acid-washed (B.D.H.) sterile sand. Sterile glass-distilled water was added to each dish in requisite amounts. Necessary amounts of the sterilised solutions of the chemicals were added to particular dishes. The petri-dishes were kept away from direct sunlight in a sterile chamber. The mercuric chloride washed seeds on crushing and plating out in a nutrient medium were found to be free from any bacterial contamination. The germination was carried out for the number of hours specified in the data presented (Tables I and II).

(b) *Estimation of nicotinic acid plus nicotinamide in dry and germinated seeds.*—Dry powdered seeds were directly weighed out (5 gm. lots) into conical flasks. After requisite period of germination the seeds from each petri-dish were separately ground with 30 ml. water and transferred quantitatively into conical flasks. 10 ml. of 12 N. sulphuric acid were added, boiled over a water-bath, centrifuged after cooling, made up to 50 ml., washing the residue twice or thrice. The nicotinic acid was determined colorimetrically using lead acetate and zinc sulphate for the deproteinisation; the colour produced by cyanogen bromide and aniline was measured in a photo-electric colorimeter according to the method described by Hawk, Oser and Summerson.²²

(c) *Estimation of ascorbic acid.*—Samples, before and after germination, were ground in a mortar to a fine paste with 6 per cent. freshly

TABLE I
NICOTINIC ACID(Figures are expressed in γ per gram of dry material)

Dish No.	Substances used in the medium	Hours of Germination								
		<i>Phaseolus mungo</i> -nicotinic acid in dry seed-20.8 γ /g.			<i>Vigna sinensis</i> -nicotinic acid in dry seed-15.4 γ /g.			<i>Cajanus cajan</i> -nicotinic acid in dry seed-19.6 γ /g.		
		24 hrs.	48 hrs.	72 hrs.	24 hrs.	48 hrs.	72 hrs.	24 hrs.	48 hrs.	72 hrs.
1	30 ml. Water (control)	24.7	30.5	39.8	18.4	23.9	27.2	22.3	27.9	30.6
2	20 ml. Water plus 400 γ desoxy-pyridoxine in 10 ml. Water	19.6	22.3	28.2	15.2	17.4	19.8	19.9	23.7	23.8
3	10 ml. Water plus 400 γ desoxy-pyridoxine in 10 ml. Water plus 7 mg. pyridoxine in 10 ml. Water	24.0	29.9	38.3	17.9	24.1	26.3	21.8	25.9	29.5
4	20 ml. Water plus 20 mg. <i>dl</i> -Tryptophane in 10 ml. Water	25.8	31.6	40.2	19.1	25.2	27.4	23.2	28.2	30.1
5	10 ml. Water plus 20 mg. <i>dl</i> -Tryptophane in 10 ml. Water plus 400 γ desoxy-pyridoxine in 10 ml. Water	20.1	23.2	29.3	15.8	17.1	20.2	19.4	24.1	23.6
6	20 mg. <i>dl</i> -Tryptophane in 10 ml. Water plus 400 γ desoxy-pyridoxine in 10 ml. Water plus 7 mg. pyridoxine in 10 ml. Water	24.2	30.5	38.9	18.4	24.3	25.6	22.1	26.3	29.1

TABLE II
ASCORBIC ACID

(Figures are expressed in mgm. per 100 gram of dry material)

		Hours of Germination									
		<i>Phaseolus mungo</i> (Ascorbic acid in dry seed = 6.37 mg./100 g.)									
Dish No.	Substances used in the medium	Water in the medium			5 ml. of 21% sol. of Glucose in the medium		5 ml. of 5% sol. of Glucose in medium		5 ml. of 21% sol. of Mannose in the medium		5 ml. of 5% sol. of Mannose in medium
		24 hrs.	48 hrs.	72 hrs.	48 hrs.	72 hrs.	48 hrs.	48 hrs.	72 hrs.	48 hrs.	
1	15 ml. Water (control)	32.7	42.31	51.81	30.73	36.78	30.81	34.65	50.05	34.60	
2	10 ml. Water <i>plus</i> 125 γ des-oxy-pyridoxine in 5 ml. Water	31.0	19.16	19.65	18.73	22.06	18.69	34.33	47.43	34.05	
3	5 ml. Water <i>plus</i> 125 γ des-oxy-pyridoxine in 5 ml. Water <i>plus</i> 1250 γ pyridoxine in 5 ml. Water	31.26	41.05	54.49	23.93	35.33	27.05	34.36	49.39	33.77	

prepared meta-phosphoric acid, glass-distilled water being used throughout these experiments. The ground sample was transferred quantitatively to a 50 ml. centrifuge tube and the contents centrifuged, the supernatant decanted and the residue again extracted three times in

a similar manner. The total extract was made up to a known volume and titrated against 0.2 ml. of the standard indophenol dye according to the method of Harris and Olliver.²³ These values were confirmed by the colorimetric method of Stotz and Robinson.²⁴

RESULTS AND DISCUSSION

The results obtained for the bio-synthesis of nicotinic acid and ascorbic acid during germination of some of the pulses are presented in Tables I and II respectively. It will be seen from Table I that during germination of pulses in water medium alone there is a gradual increase of nicotinic acid. The addition of desoxy-pyridoxine during germination markedly inhibits this increase, but the decrease in value does not fall below the original nicotinic acid value of the seed. The addition of pyridoxine hydrochloride in the concentration specified abolishes this inhibitory effect of desoxy-pyridoxine. The presence of *dl*-tryptophane in the medium to the extent of 20 mg. exerts only a slight influence, if at all, on the increase in the nicotinic acid. The more sensitive microbiological method for the detection of these smaller differences in nicotinic acid is proposed to be used in future experiments to confirm these results. But, as in the case of water medium, addition of desoxy-pyridoxine to the tryptophane medium exerts a similar deleterious effect on the increase of nicotinic acid which, however, is counteracted when pyridoxine is simultaneously added into the medium along with desoxy-pyridoxine. These results, therefore, clearly suggest that B_6 influences the conversion of tryptophane to nicotinic acid. The fact that *dl*-tryptophane added to the medium does not increase the nicotinic acid shows that the seed has enough of this amino-acid liberated or made available during the course of its germination. However, some preliminary experiments indicate that when *l*-tryptophane is added to the medium in similar amounts there is greater increase in the nicotinic acid of these pulses during germination, even though there is enough of this amino-acid originally in the seed. Whether the conversion of *l*-tryptophane to nicotinic acid is more rapid than with *dl*-tryptophane and whether vitamin B_6 has any role to play as a "coracemase" as suggested by Snell²⁵ remains to be investigated.

The results for ascorbic acid content of pulses under different conditions of germination are presented in Table II. As in the case of nicotinic acid, there is a steady increase in the vitamin C content during germination, though the increase is not as large as reported by other workers. But, what perhaps has been observed for the first time is the fact that by the addition of desoxy-pyridoxine, the influence of vitamin B_6 has been considerably affected on such a synthesis and only a small increase in the vitamin C content is observed. The large addition of pyridoxine to the medium, however,

counteracts the anti-vitamin effect of desoxy-pyridoxine and the normal increase of vitamin C content during germination is again noticeable.

Another interesting observation made in the course of these studies was the effect of added glucose and mannose into the medium during germination. It will be seen from the results that when 5 ml. of water is replaced by an equal volume of 2.5 per cent. solution of glucose, the deleterious effect of desoxy-pyridoxine was observed, while with mannose solution no such deleterious effect could be noticed. These results indicate that vitamin B_6 influences the first stage of conversion of glucose into mannose but not the conversion of mannose into ascorbic acid. Whether vitamin B_6 is acting here also like a "coracemase"²⁵ by influencing isomerisation *in vivo* of glucose to mannose remains to be elucidated. Further work is in progress.

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THE SPECTRUM OF DOUBLY-IONISED TANTALUM

THE spectrum of a highly condensed spark between rods of pure tantalum (1) in air, (2) under water, and (3) in hydrogen was photographed with quartz and glass Littrow Spectrographs. Comparative study of the occurrence and intensity of the lines in the spectra of the arc, under water spark and highly condensed spark, with and without a series inductance, helped in the selection of lines due to the second spark spectrum of tantalum. These were particularly abundant in the region λ 2250 to λ 2750.

Of the spectra of Lu—I and Hf—II, iso-electronic with Ta III, only the ground term interval

$$5d6s^2 ({}^2D_{3/2} - {}^2D_{5/2})$$

was identified by Meggers and Scribner. An approach to Ta III through iso-electronic spectra could not therefore take us farther than estimating the probable value of the above interval in Ta III as 4200 cm^{-1} . However, as V III and Cr III spectra are known, recourse could be had to the extrapolation of the $6s^4F$ term intervals of those spectra to the corresponding

ones in Ta III. It is interesting to note that though there is no chemical similarity in V III, Cb III and Ta III for the ground terms, for the md^2ms terms, however, there is perfect similarity as they arise from the d^2s configuration in all the three spectra. An application of the useful though empirical rule of proportionality of the logarithm of term interval to that of the atomic weight of the element to the

$$6s ({}^4F_{5/2} - {}^4F_{7/2}) \text{ and } 6s ({}^4F_{7/2} - {}^4F_{9/2})$$

intervals lead to an approximate estimate of those intervals and, through a search for recurring differences of that order in Ta III lines, to the regularities presented in the Tables below:

	$5f 6s^2 \quad {}^2D_{3/2}$	(4238.9) ${}^2D_{5/2}$
$6p \quad {}^4F_{5/2}$	42596.1 (8)	38358.6 (6)
${}^4D_{1/2}$	41747.5 (6)	
${}^4D_{3/2}$	42472.0 (8)	38233.6 (6)

	$^4F_{3/2}$	$^4F_{5/2}$	$^4F_{7/2}$	$^4F_{9/2}$
$p^4F_{3/2}$ 2084.6	40622.2 (8)	38766.8 (5)		
$^4F_{5/2}$ 2405.3	42705.8 (7)	40851.9 (8)	38233.6 (6)	
$^4F_{7/2}$ 2083.5		43256.9 (10)	40639.1 (5)	37493.9 (2)
$^4F_{9/2}$			42722.8 (8)	39577.2 (4)
$^4D_{1/2}$ 726.0	41856.7 (8)			
$^4D_{3/2}$ 1466.2	42582.7 (6)	40726.2 (9)		
$^4D_{5/2}$	44047.5 (6)	42193.7 (3)	39577.2 (4)	
		43285.5 (3)	40669.7 (9)	37523.8 (7)

It is interesting to note from the tables that interval rules are well obeyed as also the interval rules for higher j -values than is usually observed in complex spectra.

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PAPYROGRAPHIC SEPARATION AND LOCATION OF ANTIBIOTICS FROM PLANTS

THE antibiotic activity of the crude aqueous, alcoholic and ether extracts of the leaves of *Toddalia aculeata*, a reputed specific for dysentery, having been first found by one of us (Sirsi, M.) against the gram negative *Bact. flexneri*, it was of interest to determine if a papyrographic separation of the active principle could be accomplished.

A filter-paper strip (400 mm. \times 20 mm. Whatman No. 1) was spotted at one of its ends with a drop of crude ether extract and dried.

A glass tube (450 mm. \times 30 mm.) vertically held, lined with filter-paper moistened with ether-saturated water, was employed as the developing chamber. The tube ground at both ends was provided with wooden corks. The lower cork supported the glass trough which contained the water-saturated ether for developing the papyrogram. The cork at the top had a glass rod, the end of which was drawn into a hook from which the paper strip could be hung vertically by means of a hole punched at the opposite end of the strip. The glass rod was carefully lubricated with vaseline, so that the strip could be raised or lowered within certain limits.

After placing the water-saturated ether in the trough, the cork carrying the glass rod and the paper strip, was carefully inserted into the tubular chamber, so that the strip was kept hanging just a few millimetres above the surface of the developing solvent and without touching the sides of the chamber. The strip was allowed to remain in this position for a couple of hours, so that the filter-paper was equilibrated with the vapour phase in the chamber. By carefully pushing down the glass rod, the strip could be so lowered into the trough, that just a few millimetres of the strip dipped into the solvent, leaving the spotted area clearly above the surface of the solvent. With the capillary rise of the solvent, the papyrogram was developed. The solvent front took about 4 to 5 hours to reach the top. The rise of the solvent front could easily be followed since, it almost agreed with simultaneous ascent of the chlorophyll band. The strip, after development, is air dried and cut lengthwise into two halves. One half was employed for the bioautographic location of the "active" zone,¹ while the other was used for ultraviolet printing of the papyrogram on Ilford Reflex Paper.^{2,3} Figs. 1 (a) and 1 (b) give photographs of the clearance on the agar plate seeded with *Staph. aureus* and the ultraviolet print. It will be observed that the zone of clearance is identical with the zone of ultraviolet absorption, suggesting that the antibiotic principle has an absorption in the ultraviolet region (253.7-265 $m\mu$), a fact of considerable significance in further investigations. The circumstance that the antibiotic zone lies adjacent to the chlorophyll band is also helpful in locating the "active" region and for eluting out the antibiotic from the incised portions of the papyro-

gram. The method of combining bioautographic technique with the ultraviolet printing of the papyrogram, which has been successful in the present instance, has immense potentialities of application in a study of antibiotics from natural sources.

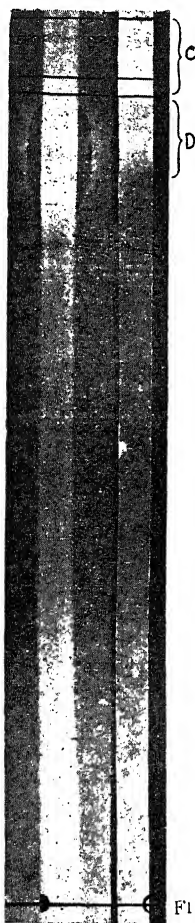


FIG. 1. a. FIG. 1. b.

FIG. 1a. Area of clearance. (Bioautography against staph. aureus).

b. Photograph of the Papyrogram of the antibiotic from an Etherial extract of *Toddalia aculeata*, taken in the Ultra Violet region. (253.7 and 265 mμ).

C. Absorption due to Chlorophyll

D. Absorption due to "Active" fraction.

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STRUCTURE OF THE NEEM (*AZADIRACHTA INDICA*) GUM

THE gum from the tree was purified by precipitation with alcohol from a concentrated acidified solution of the gum, and obtained as a white powder. Sulphated ash 0.92% : $[\alpha]_D^{21.50} - 70.6^\circ$ (c, 0.3344 in water); pentosans 15.9%; pentoses calc. on the basis of pentosans 18%, galactose residues calculated as $C_6H_{10}O_5$, 10.2% (from the yield of mucic acid obtained on oxidation of the polysaccharide with nitric acid). The gum did not give insoluble copper salt and did not reduce Fehling's solution.

The acidity of the gum was not sufficient for autohydrolysis. It was, therefore, hydrolysed with 0.05 N-sulphuric acid on water-bath (90-95°). The hydrolysis was complete in about 24 hours as determined by polarimetric and iodometric¹ observations.

The solution was cooled, neutralized with barium carbonate and filtered. The filtrate was concentrated in vacuum (bath temperature 40°) and the residue extracted with dry methanol. The methanolic extract was concentrated to a syrup which reduced Fehling's solution. It was verified to contain arabinose by forming the diphenyl-hydrazone (M.P. 195-96° alone or admixed with an authentic specimen).

The barium salt of the polysaccharide left behind after methanol extraction was further hydrolysed with 2N-sulphuric acid. The course of hydrolysis was again followed by polarimetric and iodometric observations. When the hydrolysis was complete, the solution was neutralized with barium carbonate, filtered and the solution concentrated at 40°/12 mm. The concentrated syrup was exhaustively extracted with methanol and the extract evaporated. The residue, a syrup, on treatment with methyl-phenylhydrazine gave D-galactose methyl-phenylhydrazine (M.P. 180-81° alone or admixed with an authentic specimen).

The structure of the aldobionic acid present in the gum is being worked out by methylation and hydrolysis.

Examination on the paper chromatogram of the sugars produced by the hydrolysis of the gum indicated the presence of galactose, arabinose and another sugar derivative which is most probably glucuronic acid. The chromato-

gram was developed by the improved method of Trevelyan, Procter and Harrison.²

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INFLUENCE OF VITAMIN B₁₂ ON THE BIOLOGICAL VALUE OF A LOW QUALITY PROTEIN DIET

SEVERAL workers^{1,3} have reported on the greatly enhanced growth resulting from 2 to 3 per cent. supplementation of poultry rations high in vegetable proteins with sources of 'Animal Protein Factor' (APF). This effect has since been attributed to the vitamin B₁₂ in APF.⁴⁻⁶ The association of vitamin B₁₂ with protein utilisation has been more specifically demonstrated by observations that it influences transmethylation processes,⁷⁻¹¹ reduces renal injury in experimental animals receiving low choline diets,^{12,13} enhances utilisation of circulating amino acids¹⁴ and, generally speaking, plays a fundamental role affecting the capacity of the mammal to utilise proteins.¹⁵

The present report relates to the influence of vitamin B₁₂ on the biological value, determined on three pairs of litter mate adult male rats, of a poor protein diet composed of (percentages): wheat flour, 60; defatted groundnut flour, 10; groundnut oil, 4; salt mixture (U.S.P. No. 2), 4; shark liver oil, 2; and vitaminised sucrose, 20. The vitamin additions were such that they provided the following quantities (milligrams) per kilogram of diet: thiamin hydrochloride, 2; riboflavin, 6; pyridoxine hydrochloride, 2; nicotinic acid, 20; calcium pantothenate, 10; inositol, 200; α -tocopherol, 25; and menadione, 5. Vitamin B₁₂ (Chas. Pfizer: oral grade) was added to the diet of one member of each pair of rats at the rate of 150 gamma per kilo. An iso-caloric protein-free diet for endogenous metabolism was secured by the substitution of 66 per cent. maize starch for the two flours and by increasing the groundnut oil addition to 8 per cent. The diets unsupplemented by vitamin B₁₂ were nearly free from assayable amounts of this vitamin. Biological values were determined essentially by Mitchell's balance sheet method¹⁶ which in preliminary

experiments with casein gave a mean biological value of 82.6 ± 0.33 and a mean digestibility coefficient of 93.1 ± 0 .

The cereal-legume mixture employed in these studies was on a 10 per cent. protein level (7.86 per cent. wheat protein plus 2.83 per cent. groundnut protein) and the diet provided 0.11, 0.26, 0.19 and 0.15 percentages respectively of tryptophane, methionine, lysine and cystine as compared to the percentages 0.19, 0.48, 0.74 and 0.39 respectively of these amino acids in an equi-protein casein diet. It was therefore considered poor in quality. The biological values of the vitamin B₁₂—supplemented and control groups were 75.85 ± 0.98 and 68.08 ± 0.71 respectively, while the corresponding digestibility coefficients were 90.01 ± 0.037 and 81.96 ± 2.93 . The differences were significant.

It is recognised that the method employed here for assessment of protein quality in relation to vitamin B₁₂ gives only an over-all information and does not throw light on requirements for individual metabolic processes. Further work on hyperthyroid animals and on rate of liver protein regeneration and haemopoiesis as influenced by vitamin B₁₂ with and without certain amino acid additions, particularly methionine, to low quality vegetable protein diets, is in progress.

A preliminary communication by Henry and Kon,¹⁷ showing a favourable influence of vitamin B₁₂ on the assimilation of nitrogen as casein by the vitamin B₁₂-deficient rat, has just come to the notice of the authors.

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INFLUENCE OF XANTHINE ON BIOGENESIS OF FOLIC ACID BY *LACTOBACILLUS ARABINOSUS*

THE synthesis of folic acid activity by several species of bacteria which do not require pre-formed folic acid (FA) has been reported¹⁻⁶ and related to the *para*-amino benzoic acid (pABA) content of the medium.^{2,3,6} In the course of investigations, now in progress, on the involvement of FA in purine metabolism, it has been observed that other cultural additions besides pABA exert an influence on FA biogenesis by *Lactobacillus arabinosus* 17-5.

The basal medium employed for these studies was a nicotinic acid test medium⁷ modified by the omission of pABA and inclusion of nicotinic acid (40 µg. per cent.). FA activity was measured with *Streptococcus lactis* R. (SLR) turbidimetrically⁸; for assays, the tubes were incubated at 37°.

Activity in the harvested cells was negligible while enzyme hydrolysis⁸ of the culture filtrate did not make any difference in its assayable FA. Synthesis was maximum at the end of 48 hrs. incubation and increased from 13.8 milligram (control) to 470 milligram per cent. with pABA additions up to 2 gamma per cent. There was pronounced enhancement in FA activity as a result of biotin addition and, even more so, with xanthine. Other nutrients like adenine, guanine, uracil, nicotinic acid, thiamine, riboflavin, vitamin B₁₂ and fermentation animal protein factor showed definite and varying degrees of stimulation.

The effect due to biotin (1 gamma per cent.) could also be secured by Tween 80 (0.1 per cent.), suggesting that it was probably on account of increased utilisation of nutrients as a consequence of enhanced cell permeability through surface activation. With xanthine, an addition of 0.03 per cent. had a stimulatory effect of about 2.6 times. The action of xanthine as precursor could only be explained on the basis of its providing a component unit of the FA molecule other than the pABA and presumably the pteridine moiety. The effect of glutamic acid, the third component of the FA

molecule could not be assessed properly as casein hydrolysate was the nitrogen source in the medium.

The recent recognition of FA in natural sources in the form of the physiologically more active *citrovorum* factor (CF)^{9,10} together with the observed occurrence of this in fermentation liquors,¹¹⁻¹³ prompted a study of the properties of this SLR-active substance reported above. The culture filtrate of *L. arabinosus* grown in presence of xanthine and excess of pABA was found to support growth of *L. citrovorum* (N.C.T.C.) to a greater extent than comparable concentrations of FA. It also showed a greater differential in activity in overcoming the inhibition of growth of SLR by methyl folic acid (cf.¹⁴) though, in this respect, it was not as effective as Reticulogen, Lilly⁹ and rat's urine¹⁵ when used as CF sources in equivalent FA potencies. That the culture filtrate factor was different from FA was also demonstrated from results on its distribution between *n*-butanol and water at various pH where its properties were intermediate between FA and CF (Reticulogen). Unlike rhizopterin, the filtrate factor supported growth of *Lactobacillus casei* (cf.¹⁶).

Further work on the possible nature of this FA-active substance (s) and on the related enzymes is in progress.

Our thanks are due to the Indian Council of Medical Research under whose auspices this work has been carried out.

Dept. of Chem. Tech., V. B. MITBANDER,
University of Bombay, A. SREENIVASAN.
March 10, 1951.

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Science, 1943, **97**, 465.

THE CONTRACTILE SYSTEM FOR LACTIC TONE IN UNSTRIATED MUSCLE

UNSTRIATED muscle contains two cycles for contraction. In one cycle the energy for contraction is derived from chemical stores; in the other cycle, the energy for contraction is derived from that stored in the structure.^{1,2} These two cycles operate upon two different contractile mechanisms respectively.³⁻⁶ The twitch contraction and lactic tone derive energy from the first cycle and the alactic tone from the second.

As expected, therefore, lactic tone is subserved by the same contractile mechanism as the twitch contraction. This is shown by the following observations: (1) The cardio-oesophageal part of the frog's stomach muscle shows predominantly lactic tone and the pyloric part, predominantly alactic tone; the latter can be destroyed by sudden stretch without affecting twitch, and the twitch contraction can be damaged without affecting the alactic tone.³⁻⁶ But if lactic tone in the cardio-oesophageal part is destroyed by sudden stretch, the twitch contraction is damaged (Fig. 1). (2) If during

cardio-oesophageal part of the frog's stomach muscle or the human appendix. In some muscles, the damage caused by stretching is temporary, and there is gradual recovery.

Thus the contractile mechanism for twitch contraction and lactic tone is the same. This probably accounts for the antagonism between tone and twitch. We have not noticed any antagonism between twitch and alactic tone, but have done so between twitch and lactic tone. The latter phenomenon is then, probably due to the fact that they have to compete for the same contractile mechanism.

Physiological Lab., SUNITA INDERJIT SINGH,
 Medical College, INDERJIT SINGH.
 Agra,
 April 15, 1951.

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NITROGEN FIXING CAPACITY OF THE DIFFERENT FRACTIONS OF THE SOIL

THE nitrogen fixing capacity^{2,3} of the different fractions of the manured and unmanured alluvial soil as affected by continuous cropping has been studied by adding 2.0 gm. of different fractions in 100 c.c. of Fred and Waksman (1938) medium No. 77. The flasks were then inoculated with pure culture of azotobacter and incubated for a fortnight. After incubation these flasks were analysed for their total nitrogen content. The results are incorporated in the following table.

TABLE I
*Nitrogen fixed in presence of different
 mechanical fractions in mgm. per 100 c.c.*

Fractions	Manured			Unmanured		
	0-6"	6"-1'	1'-2'	0-6"	6"-1'	1'-2'
Clay	7.35	7.80	5.35	7.29	7.92	5.49
Silt	3.86	3.44	3.09	4.63	4.42	3.72
Sand	2.05	2.11	1.55	2.32	2.97	1.97
Sand + Silt	3.85	2.95	2.21	3.97	3.54	2.71
Sand + Clay	4.25	3.97	3.05	5.40	4.90	4.07
Silt + Clay	5.97	5.67	4.52	6.98	6.03	5.21
Sand + Silt + Clay	4.75	3.87	3.25	5.74	4.85	4.35

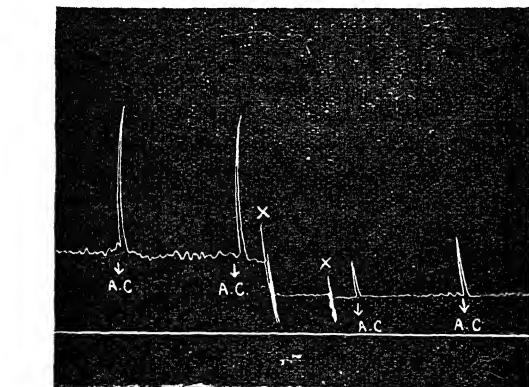


FIG. 1. Frogs' stomach muscle from the cardio-oesophageal part. The muscle is stimulated with alternating current, 10 volts for 10 seconds, every 15 minutes at A.C.; suddenly stretched at X.

twitch contraction the muscle is given a jerk, then alactic tone is not affected but lactic tone decreases. These experiments are best performed on those muscles which show twitch contraction as well as lactic tone, such as the

It is apparent from these results that the finely divided material has some physiological influence on the fixation of atmospheric nitrogen

by azotobacter. This is in agreement with the observation of McCalla (1938). This increased nitrogen fixation in presence of clay may be attributed to the localization of energy which helps nitrogen fixation. Finer the fraction, greater is the surface exposed for the absorption of the nutrients. It appears that these particles aid in fixation of nitrogen by replenishing ions in the solution when they are removed by the growing organisms.

The clay fraction of the manured and unmanured plot had more or less the same nitrogen-fixing capacity, which is of the order of 7.5 mgm., whereas the silt and sand fractions of the unmanured plot showed a greater nitrogen-fixing capacity as compared to the manured one. This greater nitrogen-fixing capacity of the coarser fractions of the unmanured plot may be one of the reasons of inherent fertility of such land.

The joint effect of these fractions, in the proportion in which they existed in the soil, on the fixation of atmospheric nitrogen showed that such a mixture of the three mechanical fractions fixed greater nitrogen in case of unmanured soil despite the fact that clay individually from both the plots had fixed almost equal nitrogen. The increased physiological efficiency of nitrogen-fixation due to the sand and silt fraction of the unmanured soil appears to be sufficient to shift the balance in favour of the unmanured plot.

Similar investigation is in progress with different species of azotobacter.

Chemistry Section, A. N. PATHAK.
Agricultural College, J. G. SHRIKHANDE.
Kanpur, S. K. MUKERJI.
January 2, 1951.

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EFFECT OF CERTAIN HORMONES ON GROWTH AND REPRODUCTION OF SOME SPECIES OF *PHYTOPHTHORA*

THE present work deals with the effect of 2,4-dichlorophenoxyacetic acid, 1-naphthylacetic acid, 3-indolylacetic acid, and γ -3-indolylbutyric acid on the growth and reproduction of the following species of the genus *Phytophthora*: *P. cryptogea* Pethyb., *P. parasitica* Dastur, *P. arecae* (Colem.) Pethyb., and *P. meadii* McRae. The fungi were grown in 150 c.c.

Erlenmeyer Pyrex flasks containing 20 c.c. of the medium which acted as control. It consisted of the same substances as that of the medium used by Leonian.² This medium will be referred to as the basal medium. Concentrations of the hormones varying from 1 part in ten thousand to 1 in one million were employed. Each set was run in triplicate. All experiments were performed at room temperature (25-28°C.) and the organisms were exposed to diffuse daylight with intervening dark periods at night, as was done by Cantino.¹ Care was taken that the inoculum was almost equal in each case. *P. cryptogea* and *P. parasitica* did not show any appreciable growth in the basal medium acting as control, while *P. meadii* and *P. arecae* did grow, but not well, in the same medium, the last named species giving best growth. The addition of hormones to the basal medium even in the lowest concentration tried did not induce any acceleration in growth. On the other hand their higher concentration showed considerable retardation in the growth of the fungi. Addition of 0.05 gm. per litre of yeast extract to the basal medium induced some growth in case of *P. cryptogea* and *P. parasitica*, and much better growth in *P. meadii* and *P. arecae*. The basal medium containing yeast extract (0.05 gm. per litre) was also supplemented with the hormones singly in concentration 1 part to ten thousand. In these media, even though the yeast extract was present, yet the hormones retarded the growth of the fungi (see Plate I).

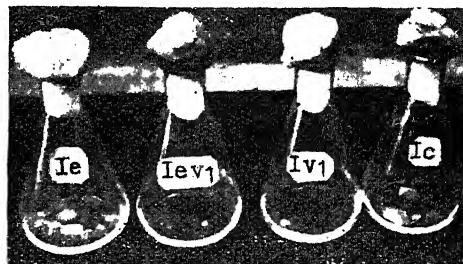


PLATE I

These fungi were also grown in the basal medium supplemented with 0.2 per cent. proteose peptone, a substance which induces growth of the fungi and not their sexual reproduction (Leonian²). A number of colonies grown in this solution were thoroughly washed in sterile distilled water and transferred to one set of flasks containing only 20 c.c. of the basal medium, and in another set of flasks containing the basal medium supplemented with 1 part in fifty-thousand of the different growth substan-

ces added singly. A microscopic examination of the colonies after intervals of one and two weeks showed that these hormones do not induce sexual stimulation in the *Phytophthoras* studied.

It is, therefore, concluded that these growth substances or hormones, which are found to stimulate growth in higher plants, are of no value to the *Phytophthoras* either as growth stimulants or as sexuality inducing agents. On the other hand, they inhibit the growth of these fungi in higher concentrations. Hence it will be better if these so-called hormones or growth substances are termed 'growth regulating substances', a term more general and self-explanatory.

Grateful thanks are due to Dr. R. K. Saxena for his help in this investigation.

Dept. of Botany,
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Allahabad (India),
September 15, 1950.

B. S. MEHROTRA.

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A NEW BACTERIAL LEAF SPOT ON *VITIS WOODROWII* STAFF.

A BACTERIAL leaf-spot was noticed on leaves of *V. woodrowii* (locally known as "Girnul") near Ambarnath (Thana) in September, 1949. The pathogen isolated in pure state from leaves produces many circular spots (0.5 to 1.0 mm.) with water-soaked margin along the main and lower side veins. Young spots which look translucent and water-soaked in early stages when held against light, later turn brown to dark-brown. When numerous, two or more spots coalesce forming irregular lesions. The centre of spots is raised; it is rough to the touch due to drying of gummy bacterial exudation. Severe infection results in the production of numerous minute specks mainly towards the base of the leaf.

Pseudomonas vitis-woodrowii sp. nov.—Short rods; gram-negative; non-capsulated; motile

with a polar flagellum; measure $1.5 \times 0.8 \mu$; not acid fast; nonspore forming; aerobic; gelatin liquefied; starch and casein hydrolysed; litmus reduced; on potato dextrose and nutrient dextrose agars colonies are round, smooth, capitate with entire margins with diameter 1.2 cm. in 7 days, colour pale gull gray (R); slow growth on potato cylinder turning it dark gray; good growth in nutrient broth in 24 hours; acid but no gas in dextrose, lactose and sucrose but no growth in salicin; ammonia and hydrogen sulphide produced; no growth in synthetic asparagin medium; M.R. and V.P. tests negative; Loeffler's blood serum completely liquefied; indol not produced; nitrates not reduced; NaCl tolerant only upto 1%; optimum temperature for growth between 25-28° C.

Pathogenic on leaves of *Vitis woodrowii*, but not on *V. vinifera*.

Detailed account will be published elsewhere.

Plant Path. Laboratory, M. K. PATEL.
College of Agriculture, Y. S. KULKARNI.
Poona,
January 8, 1951.

FRIES' REARRANGEMENT OF ALIPHATIC ESTERS OF β -NAPHTHOL

WHILE the Fries' rearrangement has been studied with various esters of α -naphthol, in the case of the β -naphthyl esters this has been reported only for the acetate.¹ We have now extended the reaction to the higher saturated aliphatic esters of β -naphthol. The reactions were tried in carbon disulphide and tetrachloroethane at higher temperatures, and nitrobenzene for lower temperatures. The first two solvents favoured the exclusive formation of ortho-hydroxy ketones, while low yields of a different product not giving Pyman's test were obtained with nitrobenzene. Eight new ortho-hydroxy ketones have thus been prepared in yields ranging from 60-100%, some of which have been characterised through their 2:4-dinitrophenylhydrazones (see table below).

Ester	M.p./b.p.	Ketone	M.p./b.p.
1 2-Naphthyl propionate	m. 46-47°	1-propionyl-2-naphthol	m. 64-66°
2 2-Naphthyl butyrate	m. 22-23° b. 140-45/23 mm.	1-butyryl-2-naphthol	m. 41-42°
3 2-Naphthyl isobutyrate	m. 42-42.5°	1-isobutyryl-2-naphthol	m. 106-08°
4 2-Naphthyl caproate	b. 200-05°/15 mm.	1-caproyl-2-naphthol	b. 205-10°/5 mm.
5 2-Naphthyl caprylate	m. 37-37.5°	1-octanoyl-2-naphthol	m. 81° (sodium salt)
6 2-Naphthyl caprate	m. 52.5-53.5°	1-decanoyl-2-naphthol	b. 252-58°/12 mm.
7 2-Naphthyl laurate	m. 54-55°	1-lauryl-2-naphthol	m. 32-33 b. 280-85°/5 mm.
8 2-Naphthyl myristate	m. 65-66°	1-myristyl-2-naphthol	m. 46-47°

This rearrangement is also being studied with the aromatic and unsaturated aliphatic esters of β -naphthol. Fuller details will be published later.

Chemistry Dept., A. B. SEN.
Lucknow University, S. BHATTACHARJI.
January 15, 1951.

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ON A NEW TYPE OF ANOMALOUS SECONDARY GROWTH FOUND IN THE STEM OF *VITIS* *QUADRANGULARIS* WALL.

THE stem is jointed and the internodes are 4-winged. In the region of the node the girdle of vascular bundles is circular and all the bundles are similar in size. The cambial activity is regular, and of the *Aristolochia* type.

In the region of the internodes, the girdle of vascular bundles is quadrangular, the bundles being separated by large medullary rays. Those that lie near the wings are much bigger. Cambial activity starts very early, but is prominent only in the region of the wings, so that, after a year or so, these bundles appear much wider, longer and larger in number due to proliferation (as mentioned for *Cissus sulcicaulis* by Solereder 1908), than those opposite the grooves. The angularity of the wing-region gradually disappears.

This irregularity continues, the activity of the bundles of the grooves being nominal, so that after the lapse of 4 to 5 years, the stem seems to be made up of four separate strands of wood, as in *Serjania ichthyoctona* (Eames and MacDaniels 1947), twisted slightly like a rope, and bound at the nodes. The intermediate groove region even disorganises, and leaves these four strands apart.

This type of anomalous secondary growth, combining the conditions found in *Serjania ichthyoctona* and *Aristolochia triangularis* (Eames and MacDaniels 1947) has not been recorded before.

Science College, J. G. SRIVASTAVA.
Patna,
December 18, 1950.

Solereder, *Systematic Anatomy of Dicotyledons* (English Translation), 1908. Eames and MacDaniels, *An Introduction to Plant Anatomy* (1947 edition).

ON AERIAL ROOTS IN *VITIS* *QUADRANGULARIS* WALL.

THE occurrence of aerial roots in *vitis* has been reported by Small (1913), Hedrick (1922), Bailey (1925), and Turner (1934) for *Vitis rotundifolia*, and by Moore (1933) for an unnamed conservatory species. Of the 75 or more species of *vitis* in India (Hooker, 1872), of which 17 occur in Bihar alone (Haines 1921), not one including the species described here, has been known to produce aerial roots. Only *V. obtecta* has its older creeping stems covered with short aerial roots (Hooker).

In *Vitis quadrangularis*, aerial roots are given out mostly in the rainy season by horizontal, as well as by oblique and vertical branches, by young as well as old stems. The aerial roots originate singly, rarely in twos, at the nodes usually by one of the sides in between the ones producing the leaf and the tendril irrespective of its orientation.

They originate from the pericycle in between the vascular bundles, or from secondary medullary rays if secondary growth has started, and not from the secondary phloem as is the usual condition (Eames and MacDaniels 1947).

The roots, as in *Tinospora cordifolia*, hang vertically down for 8-12 feet, till they touch the ground and as soon as they have done so they enter it and branch profusely, the branches running in all directions.

The roots are white at the tip, pinkish or greenish in older parts, soft and brittle and about 1/10" in diameter. As soon as the earth is pierced in, the roots start thickening till they are 1/3" or more in diameter, hard and tough.

The roots do not branch unless the tip is injured, when one or two side-branches are produced. The development of profuse underground roots on touching the soil is perhaps due to this type of injury, which is very likely, as there is no root cap.

None of the aerial roots dies at the end of the first season as happens in *V. rotundifolia* (Turner).

Both the aerial and subterranean roots show many root characters. The secondary growth is of the *aristolochia* type.

Science College, J. G. SRIVASTAVA.
Patna,
December 18, 1950.

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INDUCED VARIATION IN THE GERMINATION OF CHLAMYDOSPORES OF *USTILAGO SCITAMINEA*

VARIATIONS from the normal type in the germination of chlamydospores of *Ustilago segetum* have been recorded by Brefeld.¹ Stakman⁶ and Hitchcock⁴ have also described several types of promycelia in the germination of chlamydospores of *U. zeæ*. Kernkamp and Petty⁵ recorded twenty-five different germination types of *U. zeæ* and showed that the tendency towards a given germination type was determined by genetic factors. In *U. scitaminea*, Butler² described two different types of germination, one the usual type with a short promycelium divided into two or three cells by transverse walls with sporidia at the tip and laterally near the septa and the other one in which the promycelium grows into a branched hypha.

While studying the action of hydrophobic colloidal sulphur³ on chlamydospores of *U. scitaminea*, the author observed some interesting deviations from the normal types of germination. Germination of chlamydospores was inhibited on 1 per cent. water agar containing 20 parts per million of the fungicide. On water agar containing 10 ppm. of the fungicide, after 24 hours at 23° C. about 20 per cent. of the germinating spores showed abnormal germination. In such abnormally germinating spores 16 different germination types could be observed. The most interesting one was that in which all the four sporidia were borne at the tip of the promycelium. This type constituted about 5 per cent. of the abnormally germinating spores and resembled the usual "Tilletia type" germination in that the sporidia were borne at the tip of a non-septate promycelium. In another type the promycelium was suppressed completely and the sporidia were borne directly on the spore (Fig. 1). This

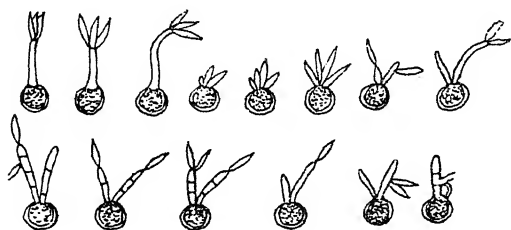


FIG. 1. Induced variations in the germination of Chlamydospores of *Ustilago scitaminea* $\times 270$.

type constituted about 3 per cent. of the abnormally germinating spores. The other types differed from each other in the types of promycelia, the number of sporidia borne on the

promycelium and the formation of buckle joints. This deviation in the germination of the spores is almost certainly due to the action of hydrophobic colloidal sulphur and not to the differences in genetic constitution of the spores, as in control plates all spores showed normal germination.

It, therefore, appears that, at least in sugarcane smut, the germination type of chlamydospores could be changed profoundly as a result of the action of hydrophobic colloidal sulphur.

Dept. of Agriculture,
Govt. of Rajasthan,

M. L. GATTANI.

Bharatpur,

January 10, 1951.

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NOCl AS A DIAZOTISING REAGENT

It was expected that NOCl should be a rich source of NO⁺ and hence should act as an effective diazotising reagent. Our results have fulfilled these expectations. The diazotisation of the amine is quick and quantitative.

The NOCl was obtained in two different ways: (i) by the action of PCl₅ on NaNO₂; (ii) by Rupe's method.¹ The diazotisation was effected by passing the NOCl into the amine under the following conditions: (a) In presence of acetic acid. (b) In presence of water. (c) In the absence of any medium. The amines used were aniline, α -naphthylamine, β -naphthylamine and the R.C. base. The temperature maintained was in the range 0 to 8° C.

A full paper describing the work in detail is being sent for publication.

St. Xavier's College,
Bombay,
February 14, 1951.

A. B. DIAS.
A. N. KOTHARE.
V. V. NADKARNY.

1. *Helv. Chem. Acta*, 1921, **4**, 149.

OBSERVATION ON THE DISEASES OF TEZPATA

THERE has been little attempt to study the pathogens of tezpata (*Cinnamomum tamala*) much used as aromatic ingredient and spice in cooking all over the world. Tezpata leaf suffers from various diseases caused by insects and fungi as well.

Many of the leaves form a large number of small galls which are mainly caused by insect-bite. Small insects lay eggs in the spongy cells, which, on stimulation, bulge out on the upper surface of the leaf, distorting it with galls and damaging it.

Shot holes and leaf-spot diseases are not uncommon. So far two species (*Pestalozzia cinnamomi* and *Cercospora* Sp. of *Fungi imperfecti*) have been found to cause the diseases when plants are grown in shade and crowded condition.

Spore fruits of *Pestalozzia cinnamomi*, when mature, emerge as black pointed tips on the lower surface of the diseased leaf, as seen macroscopically. In the host tissue, the hyphae are interwined into a stromatic layer forming a saucer-shaped cavity, within which thousands of conidia are borne directly on the stromatic layer. Conidium is fusiform 5-celled, golden brown except the basal and apical cells; the latter is terminated by 3 stiff hairs. Conidium is 27 microns \times 8 microns in size.

Spots caused by *Cercospora* Sp. are dark-brown and zonate. Conidiophores which develop from the superficial felty growth of the mycelium are septate and wavy. Conidium is hyaline to faintly yellowish, 4 to rarely 5-celled, elongated spindle shaped, with rounded apex and somewhat acute base, $52\mu \times 5.5\mu$ in size. Mycelium and conidiophore are septate, thick-walled, dark brown 3.5μ in thickness.

Comparative study of the specific characters and other aspects of the pathogens will be published elsewhere.

Dept. of Botany,
Sylhet Govt. College,
East Bengal,
February 28, 1951.

S. M. A. RAHMAN.

SORGHUM VERSICOLOR, ANDERSS— A SPECIES HIGHLY RESISTANT TO STRIGA

THE phanerogamic root parasite *Striga* is represented in India by four species, viz., *Striga lutea*, Lour., *S. densiflora*, Benth., *S. euphrasioides*, Benth. and *S. orobanchioides*, Benth. Since 1933, the Economic Botanist to the Government of Bombay has been breeding *Striga* resistant varieties using the local and exotic Jowar types like *Bilichigan*, *Mudinandyal* and *Bonganhilo*, which are fairly resistant to *Striga lutea*. The last one from Tanganyika is, in addition, fairly resistant to *Striga densiflora*.

With a view to explore additional sources for resistance, a collection of 35 *Sorghum* species and varieties of *Sorghum vulgare*, Pers., was subjected to an artificial infection of *Striga*. These types, with a susceptible local variety as control, were sown in earthen pots in the open, in triplicate. They were sown with a seed mixture of virulent ecotypes of *Striga lutea* (from Mundargi, Dharwar District) and *Striga densiflora* (from Indi, Bijapur District). Most of the *Sorghum* types showed varying degrees of infection except *Sorghum versicolor*, Anderss. (accession number 159), *Sorghum conspicuum*, Snowden and *Sorghum vulgare*, Pers. var. Atlas Sorgo.

These three *Sorghum* types were subjected to a second rigorous test along with the susceptible control in a glass house, where the prevailing humidity and temperature provided a near approach to the optimum conditions favouring *Striga* infection. *Sorghum versicolor* did not show any infection in any of the five replications during the entire period of growth. *Sorghum conspicuum* and Atlas Sorgo were considerably more resistant than the control but their resistance failed during the later stages of growth.

A third test was conducted on the above three *Sorghum* types along with the existing resistant type *Bonganhilo* and a local susceptible type *Maldandi* as controls. There were seven replications with seven pots in each replication and a mixture of all the available ecotypes of *Striga lutea* and *Striga densiflora* was used for artificial infection in two heavy doses, one at sowing time and another during the preflowering stage. The results are summarised below (see Table I).

It is seen that none of the plants of *Sorghum versicolor* was affected by *Striga*. In the case of *Sorghum conspicuum*, out of 24 plants affected, the parasite belonged to *Striga lutea* and none to *Striga densiflora* to which it appears to be resistant. In the case of Atlas Sorgo, the

1. Butler, E. J. and Bisby, G. R., *Scientific Monograph*, 1931, No. 1. 2. Mundkur B. B., *Ibid.*, 1938, No. 12. 3. Butler, E. J., and Jones S. G., *Plant Pathology*, 1949. 4. Chaudhury, S., *Journal of Indian Botanical Society for August 1946*.

TABLE I

Name of the type	Number of seeds		Number of plants affected	Percentage of host plants affected
	Sown	Germinated		
<i>Sorghum versicolor</i>	..	49 38	nil	0%
<i>Sorghum conspicuum</i>	..	49 44	21	54.5%
<i>S. vulgare</i> , var. Atlas sorgo	..	49 39	24	61.5%
<i>S. vulgare</i> var. <i>Bonganhilo</i>	..	49 49	11	22.4%
<i>S. vulgare</i> var. <i>Maldandi</i>	..	49 48	33	68.7%

affected plants showed 80 per cent. *Striga lutea* and the rest *Striga densiflora*.

An additional 28 *Sorghum* species and varieties were received later, and subjected to a preliminary experiment with five pots for each type similarly subjected to artificial infection of *Striga*. In this experiment, *Sorghum purpureosericeum*, Sch. and Asch., and *Sorghum nitidum*, Pers. did not show any infection whereas all other *Sorghums* were affected by *Striga*.

Sorghum versicolor which proved to be highly resistant in three successive trials as also *Sorghum purpureosericeum* and *Sorghum nitidum* which tentatively show indications of being resistant to *Striga*, all belong to the section *Para-Sorghums* (beared nodes and simple panicle branches). They have $2n = 10$ chromosomes as compared to *Sorghum vulgare* which has $2n = 20$ chromosomes and belongs to the section *Eu-Sorghums*. In the light of the above observations, *Para-Sorghums* may prove to be of considerable importance in evolving varieties of *Sorghums* resistant to *Striga*. However, in view of the known difficulties in their hybridisation and their different chromosome numbers, it would require an elaborate cytogenetic technique in order to effect the transfer of desirable characters from *Para-Sorghums* to the cultivated *Sorghums*.

I am indebted to Prof. L. S. S. Kumar for the guidance. I am thankful to Shri. M. V. Gadre for the help rendered and to Shri. J. G. Oke, Shri. A. V. Gokhale and Shri. V. R. Karmarkar for conducting the confirmatory trials. Seeds of *Sorghum versicolor* were supplied by Dr. David J. Ward of United States Department of Agriculture, and of *Sorghum nitidum* by Dr. William Hartley of the Division of Plant Industry, Australia. The seeds of *Sorghum*

purpureosericeum were collected around Poona by Dr. Solomon and the author.

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March 18, 1951.

THE DISTRIBUTION OF VITAMIN C IN SOME COMMON GASTROPODS AND ITS BIOSYNTHESIS IN *PILA VIRENS* LAMARCK (MOLLUSCA-GASTROPODA)

BOURNE¹ has stated that little information is available on the vitamin C content of the eggs and early embryos of various animals. Here is reported a study of the distribution of vitamin C in some gastropods and also in the ontogeny of one of them, *Pila virens*.

In the adult stage of *Pila*, vitamin C can be recognised in the connective tissues of different organs, salivary glands, oesophagus, stomach, intestine, testis and the digestive gland, which on titrimetric estimation with 2,6-dichlorophenol indophenol, was found to contain a relatively larger amount (19.9 mgm. per 100 gm. of the tissue), a value which compares favourably with that of some plants.

The distribution of vitamin C was also studied in *Viviparus*, *Achatina*, *Oliva*, *Turritella* and a few other gastropods, both freshwater and marine. In *Viviparus* the distribution of vitamin C in the digestive gland is similar to that found in *Pila*. *Achatina* shows an interesting distribution of vitamin C as it is intracellular, being concentrated towards the distal ends of the cells of the digestive gland. The digestive glands of *Oliva* and *Turritella* show a similar distribution.

The distribution of vitamin C in the ontogeny of *Pila virens* presents interesting features. The embryonic stages and the juvenile stages till about the tenth day after hatching, whether fed on their natural diet or starved, do not show any trace of vitamin C. Some of the juvenile stages were also fed on fruits rich in vitamin C like oranges, but failed to show any trace of vitamin C.

The absence of vitamin C in young animals and its appearance in later stages suggests the possibility of biosynthesis of vitamin C in the tissues of *Pila*. Experiments were devised to determine the stage at which vitamin C gets synthesised in the animal. Young specimens which were fed, some on boiled rice, and some on filter-paper for a fortnight from the time of hatching, showed the first traces of vitamin C on the twelfth day, and on the four-

teenth day most of the specimens that were examined showed vitamin C. Control experiments were set up in which the specimens were starved for the same duration, and there was no trace of vitamin C in them. A few of the starved ones were separated on the thirteenth day and fed, some on boiled rice and some on glucose, for twenty-four hours. Those fed on glucose showed vitamin C, but those fed on boiled rice showed only traces of it. It is evident that vitamin C is synthesised in the tissues of *Pila virens* more readily from glucose.

The synthesis of vitamin C in animal tissues has been known so far to occur in the rat, the rabbit, and the chick. The synthesis of vitamin C in *Pila* is therefore of interest.

My thanks are due to Dr. A. Sreenivasan, Bombay, and Dr. Sarma, Madras University, for some references, and to Prof. R. V. Seshaiya for guidance.

Zoology Dept., (Miss) V. R. MEENAKSHI.
Annamalai University,
Annamalainagar,
March 10, 1951.

Bourne, G., *Cytology and Cell Physiology*, 1942.

THE PERITHECIAL STAGE OF *ERYSIPHE POLYGONI* DC. ON PEA (*PISUM SATIVUM* LINN.)

The perithecial stage of the powdery mildew, *Erysiphe polygoni* DC. was observed on 26th July 1950, on the leaves of pea (*Pisum sativum* L.), cultivated in fields near Bangalore.

The crop was about three months old and in pods. The rainfall in July ranging from a trace to 63 cents per day was fairly well distributed throughout the month except for short breaks on the 9th, 10th, 18th and 19th. The week just prior to the observation received continuous rainfall varying from 2 to 38 cents per day. The highest maximum and the lowest minimum temperatures during the period two weeks prior to the observation was 82.4° F. and 63.8° F. respectively, and those for the two sub-

sequent weeks were 84.5° F. and 64.8° F. respectively. The relative humidity ranged from 76 to 95 per cent. during July.

The perfect stage of *Erysiphe polygoni* is of rare occurrence in India. Butler and Bisby² record the occurrence of the parasite on *Pisum sativum* in Dehra Dun, Pusa, Verinag, Kashmir and Maymyo. Most of their perithecial collections originated in the north either in hills or the Indo-Gangetic plain where there is a distinct cold season. Butler³ describes in detail the perithecia on peas. His measurements are apparently taken from Salmon. Uppal, Patel and Kamat⁴ state that the conidial stage is the only one found.

The perithecia were observed by the writer on some of the severely infected leaves on the plant as black bodies, scattered in small groups on the white floury patches. They were present on both the surfaces of the leaf. They are small, round and orange to brown coloured turning dark-brown to black later. They consist of distinct polygonal cells and possess 24 to 46 long, simple, sparsely septate, free and spreading appendages. The appendages are brownish in colour and measure 79 to 174 μ in length. The asci are limited in number, one or two in a perithecium. They are globular or ovate, almost sessile and hyaline. Four to six ascospores are observed in an ascus. The ascospores are hyaline, ovate, and single-celled. The measurements of the reproductive structures observed by the writer in Mysore (South India) correspond as shown in the following table to

TABLE I

	Butler (apparently from Salmon)	Blumer's mid-European strain of <i>Erysiphe pisi</i> as given by Bremer, <i>et al.</i>	Mysore (N.S.V.)
1 Perithecia	90 μ	85-126 μ	95-134.5 μ
2 Ascus No.	2-8	..	1-2
" Size	46-72 $\mu \times 30-45 \mu$	50-60 $\mu \times 30-40 \mu$	31.5-63 $\mu \times 31.5-39.5 \mu$
3 Ascospores No.	3-8	..	4-6
" Size	19-25 $\mu \times 9-14 \mu$	22-27 $\mu \times 13-16 \mu$	16-24 $\mu \times 8-16 \mu$

those of the Central European species of Blumer as given by Bremer, *et al.*¹ rather than those given by Butler.³

I am thankful to Sri. S. V. Venkatarayan, Plant Pathologist, for kind encouragement and helpful suggestions in the course of this work.

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Plant Pathology Section,
Agricultural Department,
Bangalore,
December 1, 1950.

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**A PALM FRUIT FROM KAPURDI
(JODHPUR, RAJASTHAN DESERT)
COCOS SAHNII Sp. Nov.**

DURING my survey work of Western Rajasthan, I investigated a collection of fossil impressions on Fuller's Earth taken out from the mines at Kapurdi, known for its early tertiary (Eocene) remains. One of the impressions came out to be *Cocos* species (see Photograph). The full description will be given elsewhere. I have named it after the late Prof. B. Sahni. It is



FIG. 1. Remains of the endocarp of *Cocos sahnii* showing the two eye like depressions at one end. $\times 1$.

worthy of note that the fossil stem *Palmoxyylon Sundaram* Sahni from Sagaur (C.P.), was identified by me in 1938 as a *Cocos* stem and was accepted by Prof. Sahni as such. This discovery of fruit confirms my view that *Cocos* was known in India in early tertiaries.

Herbarium, K. N. KAUL.
The National Botanical Garden,
Lucknow,
March 6, 1951.

**CYTOPLASMIC INHERITANCE IN
*SACCHARUM***

THE theory of the "plastogene"¹ recognises the existence of determinants outside the nucleus

attached to the plastids having all the properties of nuclear genes including permanence. The existence of another set of extra nuclear determinants "plasmagene"² is vouched for by non-mendelian inheritance of which reciprocal differences are the simplest evidence. Breeding results in reciprocal hybrids in *Linum*,^{3,4} *Nicotiana*⁵ and *Zea*⁶ have indicated that certain characters, especially male sterility, are determined at least in part by some condition of the cytoplasm.

Interspecific hybrids in *Saccharum* are not usually identical reciprocally. The species involved are *S. officinarum*, *S. spontaneum*, *S. barberi* and *S. robustum*. The gross appearance especially in respect of habit and thickness of stem, of reciprocal crosses, in some cases is so glaringly maternal that it sets one thinking if it could not be a case of cytoplasmic inheritance, at least in part in the sense that it could be a case of interaction between genes and cytoplasm. The problem is rendered more interesting in view of the fact that interspecific hybridization in *Saccharum* does not always involve the union of the haploid parental genomes. If inheritance was purely genic one would expect the hybrid to resemble that parent which had contributed the larger number of chromosomes. In some instances even though the male parent contributed the $2n$ number, the resemblance of the hybrid is more to the maternal parent which contributed the usual haploid number. In some crosses the egg is known to contribute neither its haploid nor its diploid number. The various crosses and reciprocal crosses with their relevant chromosome numbers are given in brief in Table I. The general configuration of the hybrid appears to be influenced greatly by the cytoplasm of the egg parent. However, it is not suggested that this phenomenon is universal among all the varieties of *Saccharum* species. For instance, while it is marked when the varieties like Chittan and striped Mauritius are used, it is not so pronounced when others like Kaludai Boothan or Black Cheribon are involved. It may well be that this phenomenon of cytoplasmic inheritance is confined only to some varieties.

Support to the view of the existence of cytoplasmic inheritance is to be found in the manifestation of maternal inheritance with regard to the phenomenon of male sterility. Dutt and Krishnaswami⁷ and Dutt and Rao⁸ have recorded this phenomenon in some spontaneum hybrids. An analysis of the available hybrids suggested that this phenomenon revealed itself only when *S. spontaneum* was involved in the

TABLE I

Parents and their haploid chromosome number					Hybrids		
No.	Female		Male		Chromosome No. and how derived	Gross appearance (Habit and thickness of stem)	
1	A.	<i>S. officinarum</i> (K. Boothan)	40	<i>S. spontaneum</i> (Coimbatore)	32	112 ($2n + n$)	Like <i>officinarum</i>
	B.	<i>S. spontaneum</i>	32	<i>S. officinarum</i> (K. Boothan)	40	112 ($n + 2n$)	Like <i>officinarum</i>
	C.	<i>S. officinarum</i> (Chittan)	40	<i>S. spontaneum</i>	32	$2n = 112$ ($2n + n$)	Like <i>officinarum</i>
	D.	<i>S. spontaneum</i>	32	<i>S. officinarum</i> (Chittan)	40	$2n = 112$ ($n + 2n$)	Like <i>spontaneum</i>
2	A.	<i>S. officinarum</i>	40	<i>S. robustum</i>	36	$2n = 76$ ($n + n$)	Intermediate
	B.	<i>S. robustum</i>	36	<i>S. officinarum</i>	40	$2n = 76$ ($n + n$)	Intermediate
3	A.	<i>S. robustum</i>	36	<i>S. barberi</i>	46	$2n = 82$ ($n + n$)	Like <i>S. robustum</i>
	B.	<i>S. barberi</i>	46	<i>S. robustum</i>	36	$2n = 82$ ($n + n$)	Like <i>barberi</i>
4	A.	<i>S. barberi</i>	46	<i>S. spontaneum</i>	32	$2n = 78$ ($n + n$)	Like <i>barberi</i>
	B.	<i>S. spontaneum</i>	32	<i>S. barberi</i>	46	$2n = 78$ ($n + n$)	Like <i>S. spontaneum</i>
5	A.	<i>S. barberi</i>	46	<i>S. officinarum</i>	40	$2n = 86$ ($n + n$)	Like <i>S. barberi</i>
	B.	<i>S. officinarum</i>	40	<i>S. barberi</i>	46	$2n = 126$ ($2n + n$)	Like <i>S. officinarum</i>

cross as the pistil parent. To clarify this point a number of crosses, reciprocal crosses and back crosses were studied, the results of which are briefly indicated in Table II, especially with reference to this particular character of male sterility.

TABLE II

Parents		Hybrid Diploid number and how derived	Male Sterility present absent + -
Female	Male		
<i>officinarum</i>	<i>spontaneum</i>	112 ($2n+n$)	-
<i>spontaneum</i>	<i>officinarum</i>	112 ($n+2n$)	+
<i>barberi</i>	<i>spontaneum</i>	78 ($n+n$)	-
<i>spontaneum</i>	<i>barberi</i>	78 ($n+n$)	+
* <i>spontaneum</i>	<i>sclerostachya</i>	79 ($2n+n$)	+
* <i>spontaneum</i>	<i>narenga</i>	79 ($2n+n$)	+
* <i>spontaneum</i>	<i>crianthus</i>	84 ($2n+n$)	+
* <i>spontaneum</i>	<i>sorghum durra</i>	74 ($2n+n$)	+

* Reciprocal crosses of these have just been made and in such of those as in which seedlings result, the expectation is that there will be no male sterility. But the presence of this feature in all these crosses involving *Spontaneum* as the mother is worth noting. The possibility of male sterility being due to the intergeneric nature of the cross must not also be overlooked. But in one known intergeneric cross not involving *Spontaneum* as the pistil parent, the phenomenon has not been seen, i.e., *Officinarum* \times *Sclerostachya* ($2n+n$).

The crossing results obtained so far lead one to the following tentative conclusions:—The difference in inheritance is due to a dissimilarity in the cytoplasm of *Spontaneum* on the one

hand and the other forms involved on the other, like *Officinarum*, *Barberi*, etc. Individuals of the F_1 and later generations, both F_2 and back-crosses, resulting from the cross between *Spontaneum* as the female and the others as the male parents, would have cytoplasm contributed by *Spontaneum* whereas the progeny of the reciprocal crosses would have the cytoplasm of the other respective parents. A particular gene or group of genes or even a whole chromosome for bisexuality from *Spontaneum* and *Officinarum* would appear to react normally in their respective cytoplasm. A certain combination of factors seems to produce different phenotypic effects depending upon the derivation of the cytoplasm. When the genes are in a heterozygous condition in *Spontaneum* cytoplasm male sterility is the consequence. If present in that condition, say in *Officinarum* cytoplasm as when *Officinarum* is used as the pistil parent, there is no male sterility. Nor is there an expression of this feature when the genes are in a homozygous condition in *Spontaneum* cytoplasm as in the selfed diploid derivatives of *Spontaneum* or as when *Officinarum* genes come to be implanted in *Spontaneum* cytoplasm by successive back-crossing of *Spontaneum* by *Officinarum*. In other words, the nuclear genes of *Officinarum* and *Spontaneum* are reacting with the plasma-genes of the latter resulting in this defect. A study of the available selfed and back-crossed progeny of the F_1 's seems to support the view presented above. In two seedlings of the back-crossed progeny *Spontaneum* \times *Sclerostachya* \times *Sclerostachya*, the phenomenon is present in

one and absent in the other, which is according to expectation. Because if it were purely cytoplasmic as in Wettstein's *Funaria*, all the back-crossed progeny would show this feature. Since however, it is believed to be a result of the reaction between nuclear genes and cytoplasm, only in those in which the former are in a heterozygous condition in *Spontaneum* cytoplasm, does the phenomenon of male sterility manifest itself. Hence the expectation in the back-crossed progeny is 1 : 1. However, since these are selected seedlings, we have no idea of the large number that would have been rejected in the nursery. That in any case it is cytoplasmic, can be inferred in a negative way by the complete non-occurrence of male sterility in *Officinarum* \times *Spontaneum* \times *Officinarum* as also in *Officinarum* \times *Spontaneum* selfs, because in both cases the concerned nuclear genes though heterozygous (in half the progenies) are in *Officinarum* cytoplasm whereas in the F_2 of what in essence are reciprocal crosses in the sense that *Spontaneum* is the female (e.g., *Spontaneum* \times *Sclerostachya* and *Spontaneum* \times *Narenga*; though pollen sterile, a few grains are sometimes available in the F_1 's to take them to F_2 's) the phenomenon is present in the few selected seedlings that are available, since it is in *Spontaneum* cytoplasm that the genes are associated in a heterozygous condition. However, if the entire F_2 population is examined the expectation is that half the number would show this feature, the other half being bisexual. It thus appears that nuclear genes and plasmagenes fit one another in heredity in certain ancestral combinations, but fail to do so in certain recombinations produced by crossing. The most common expression of this failure is male sterility. We cannot, however, count upon either absolute constancy or absolute matrilinear descent, as sorting out of the plasmagenes and contamination by pollen cannot be ruled out altogether.

If the cytoplasm of *Spontaneum* is so distinct from that of the other forms as to change the

phenotypic expression of the genes for bisexuality, it may be expected to have at least some effect on the expression of all the other genes. This seems to be the case at least in some cases as for instance in *Spontaneum* \times *Barberi*; *Spontaneum* \times *Officinarum*, where there are reciprocal differences as regards habit, stature and thickness of stem, in addition to male sterility. However, only where *Spontaneum* is involved is there the expression of male sterility. In some crosses not involving *Spontaneum*, the reciprocal differences are confined to other characters than male sterility, e.g., *Barberi* \times *Officinarum*. This would be comparable to the case of tomato⁹ where the difference is one of size and expressing itself in F_1 and in the segregating F_2 . It is also conceivable that male sterility alone is the outward expression of this interaction, unassociated with other differences of size and habit, in reciprocal crosses. It may then be that the action of all the genes is affected only in respect of that character while in regard to other characters their action is presumably unchanged.

Further experimental work is in progress. The evidence available at present cannot by any means be said to be conclusive. Further studies that are in progress may or may not substantiate the interpretation herein presented tentatively.

T. S. RAGHAVAN.

Sugarcane Breeding Station,
Coimbatore,
December, 1950.

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1851 EXHIBITION SCHOLARSHIP

THE Royal Commissioners for the Exhibition of 1851, London, have awarded the Science Research Scholarship for the year 1951 to

Shri. Kamla Kant Pandey, Research Scholar at the Indian Agricultural Research Institute, New Delhi.

REVIEWS

Conductimetric Analysis at Radio-Frequency.
By G. G. Blake. (Publisher: Chapman and Hall). Pp. 109. Price 15 sh.

The author has described in this book a new method of radio-frequency analysis which may be used for analysis and titration of solutions, for studies in diffusion and the rate of progress of chemical reactions in solutions. The method consists in setting up a high-frequency oscillator with proper shielding, the plate current being measured by zero-shunted micro-ammeter, and the lead carrying the radio-frequency output from a coupling condenser being attached to a metal sheath or a spiral enclosing a thin pyrex glass tube which contains the solution under study. Variations in experimental method have been suggested to suit different types of analytical work.

It is found that the plate current through the zero-shunted micro-ammeter depends on the concentration of electrolytes in the solution. Hence such concentrations can be estimated, if necessary, by using previously determined calibration curves.

The experimental arrangement is simple and deserves to be tested in physico-chemical laboratories where it is intended to simplify and lighten the work of the analytical chemist.

J. C. G.

Products and Processes: India's Natural Resources and Their Use in Industry. By G. R. Kelkar and M. S. Varde. (Published by MacMillan and Co., Ltd., MacMillan Building, 276, Hornby Road, Bombay). Pp. 121. Price Rs. 1-10-0.

The book under review is a welcome departure in this field. The subject-matter of the eight different chapters (Common Salt, Hides, Oilseeds, Minerals, Fertilisers, Rubber, Hides, Skins and Bones, and Shellac) has been well chosen even though one feels that there are other products which are equally important to India and which might have found a place in the book. This would perhaps increase the size of the book, which is confined to 121 pages and priced at the moderate figure of Rs. 1-10-0. One can only hope that a second volume will soon follow the present excellent production relating to other important products in which India holds a prominent position, such as (a) manu-

facture of jute products; (b) tea; (c) sandalwood oil; (d) cashewnuts and others.

Also, it would be of value to mention India's deficiency in important minerals containing tin, lead, zinc, sulphur, silver, graphite, nickel, tungsten, molybdenum, etc.

We are sure that the facts and figures mentioned in the text will be made up to date and various inaccuracies such as the solubility of oil in alcohol, etc., be corrected in a future edition. We welcome this book and recommend it to the general average reader.

S. G. SASTRY.

The Actinomyces—Their Nature, Occurrence, Activities and Importance. By Selman A. Waksman. (Chronica Botanica Co., Waltham, Mass., U.S.A.), 1950. Pp. xviii + 230. Price \$ 5.00.

Actinomyces, a group of widely distributed and a much neglected group of micro-organisms, have formed the subject of patient, thorough and intensive studies for over three decades, principally, by Waksman and his school. These studies demonstrated the importance of their role in Nature's cycles of carbon and nitrogen. Among this group are to be found causative agents of disease, spoilage and deterioration, sources of enzymes and vitamins and in recent years, of powerful antibiotics which have been responsible for a deeper awakening of the interest shown by scientific investigators in this field.

This volume is a timely contribution by a celebrated worker whose life-long and active association with these organisms, entitles him to write on this subject with singular authority. In a series of well-planned twelve chapters, the author deals with the taxonomical, morphological, metabolic and other aspects of these organisms. The fourth chapter on variations and mutations among them, is worthy of close study. The seventh chapter on the antagonistic properties of actinomyces and production of antibiotics is one which will be eagerly read by all biochemists since it gives a first-hand, living and vivid account of the discovery and production of antibiotics. This is a volume which will be eagerly welcomed by everyone interested in actinomyces and antibiotics,

Newer Methods of Preparative Organic Chemistry. Translated and revised from the German. (Interscience Publishers, Inc., New York), 1948. Pp. xiii + 657. Price \$8.50.

Pre-war Germany had occupied a pre-eminent position in the field of organic chemistry because of her substantial contributions to, and spectacular achievements in, this branch of science. Under the stress of the World War II, many new advances in methods of preparative organic chemistry were made and these, which were first published in 1940, were brought out in the form of a book in 1942. A second edition of this was issued in 1944 but on account of the war then in progress, none of these editions were available to the rest of the world's laboratories.

The credit of making these valuable articles readily available to the English-speaking chemists, belongs to the enterprising Interscience Publishers, Inc., under whose auspices, a group of American scientists have translated and "contributed substantially to an improvement and adaptation of the original German text".

The subjects dealt with in the volumes are, (1) Oxidations with lead tetraacetate and periodic acid; (2) Dehydrogenation with sulphur, selenium, and platinum metals; (3) Reduction with Raney Nickel Catalysts; (4) Hydrogenation with copper chromite catalysts; (5) Meerwein-Ponndorf reduction and Oppenauer oxidation; (6) The use of biochemical oxidations and reductions for preparative purposes; (7) Substitution reactions of aliphatic compounds; (8) Organic fluorine compounds; (9) Catalysts of organic reactions by Boron fluoride; (10) Use of hydrogen fluoride in organic reactions; (11) Methods for the thiocyanation of organic compounds; (12) The Diene synthesis; (13) Syntheses with diazomethane; and (14) Syntheses with Organolithium compounds.

The fundamental principles underlying each of these organic reactions are discussed and their appropriate applications in the preparation of organic chemicals and also in the elucidation of their structure, are indicated. Suitable examples are given.

This modestly priced and neatly got-up volume will be found indispensable to every organic chemist.

Progress in Chromatography, 1938-47. By Prof. L. Zechmeister. (Chapman & Hall, Ltd., London), 1950. Pp. xviii + 388. Price 45 sh. net.

The volume under review represents a companion volume to the author's previous treatise

on the *Principles and Practice of Chromatography*, and gives a comprehensive bibliographical survey of the widely scattered and difficultly available contributions to the rapidly developing field of chromatography during the last decade.

Twenty-three chapters cover every aspect of the subject; the general section deals with the principles and the methods, while the chapters in the special section are devoted to a consideration of the progress made in the chromatography of important groups of naturally occurring compounds, viz., chlorophylls, porphyrins, bile pigments, carotinoids, miscellaneous natural pigments, lipoids, carbohydrates, amino acids and peptides, sterols, alkaloids, hormones, enzymes, vitamins, antibiotics and other biological principles. Advances in the applied aspects of chromatography are described in the 22nd chapter while the last chapter deals with inorganic chromatography. There are also chapters which deal with organic chemicals including synthetic dyestuffs.

This simple, elegant but nevertheless, versatile and effective technique of chromatography is being extensively and successfully employed in almost every branch of pure and applied chemistry and hundreds of papers are appearing in scientific journals every year. The author has accomplished the difficult task of collecting and classifying the literature in a single volume, documented with references to literature. The volume will be gratefully welcomed by the very large and ever-increasing number of investigators who have adopted this technique as a useful and powerful tool in their experimental armoury. A decennial publication of such volumes in future will serve not only in taking stock of the literature, but also in stimulating further progress in this field.

Calculating Instruments and Machines. By D. R. Hartree. I Eng. Edn. (Cambridge University Press), 1950. Pp. ix + 138. Price 12 sh.

This is an almost exact reproduction of the first edition published in U.S.A., containing an account of a series of lectures given by the author at the University of Illinois in 1948. The book deals more with the principles of the various instruments rather than with the details of construction of any particular one. In fact, only selected topics have been discussed, namely, those about which the author has first-hand experience. Perhaps the most instructive chapters are those on the differential analyser. But the one on other instruments such as those for

solving algebraic equations, making Fourier synthesis, etc., gives very little information and leaves one unsatisfied. The digital machines, both mechanical and electronic, are treated particularly well and Prof. Hartree has given the

readers the benefit of his rich experience in the form of a fine analytical account of their working. The book is warmly recommended both to designers and to users of computing machines.

HILSA INVESTIGATIONS IN THE NARBADA*

TWO of the most important families of fish as food for mankind are the Clupeoids (Herring family) and Gadide (Cod family). The latter family is practically unrepresented in Indian water, but the Clupeoids are abundant. Quite a number of members of the Salmon and Herring families live parts of their lives in the sea, ascending rivers to a greater or less distance to spawn. Some spawn near the termination of the tidal rise, others ascend the rivers for vast distances. The striking result of this is that these fish, when overfishing takes place, are more amenable to depletion than fish which spend all their lives in the open sea. Consequently, information as to the spawning habits of these fish is of direct economic importance, and Dr. Kulkarni in these researches is to be congratulated on extending our knowledge of the spawning of the Hilsa, certainly one of the most important, if not the most important, of Indian fish.

It has long been known that the Hilsa ascend certain Indian rivers, e.g., the Ganges to considerable distances and it was reasonable to assume that this migration was for spawning purposes. In June and July 1909, the writer of this review attempted to locate spawning ground of Hilsa in the Ganges without success, though ripe males and females which had evidently recently spawned were obtained at Sara Ghat, Rajmahal and Monghyr. In spite of the most careful search no eggs or larval fish were obtained. Late in September ripe males were obtained at Monghyr. So the mystery of the spawning grounds of the Hilsa remained un-

solved until Dr. Hora in 1938 discovered spawning grounds at Pulta.

Now we have, thanks to Dr. Kulkarni, a detailed account of the spawning habits, eggs and young Hilsa from the Narbada. It appears that many, if not most, shoals of Hilsa in that river spawn at or about tidal limits in this respect resembling the Smelt (Salmon family) of English rivers. The author gives an excellent, lucid and detailed account of the eggs and young of the Hilsa with illustrations. There is also a map showing the positions where the eggs were obtained. All this information is most valuable, and should overfishing occur, as it may well do, the author's paper will be reliable as a source of any regulations that have to be made. The excessive preponderance of ripe males to females corresponds with our experience on the Ganges. A more detailed account of the extent of the spawning grounds in the Narbada River and also the fate of those shoals which ascend the river to Garudeshwar will be quite useful.

Dr. Kulkarni rightly draws our attention to the fact that while the Hilsa spawns relatively near the tidal limits on the west coast, it does ascend to considerable distances in the Ganges and Indus, even though a spawning was discovered by Dr. Hora at Pulta. We know that in the case of the two European Shads, one ascends rivers to a considerable distance whereas the other spawns near tidal limits. Can it be that there are two varieties of Hilsa, one the same as the above, while the other spawns immediately on reaching fresh water? There is also the question of the development and location of what may be termed the post-larval stages of the Hilsa. My own experience was that little or nothing was known of these stages. The duration of the spawning period should also be investigated.

* *Breeding Habits, Eggs and Early Life-History of the Indian Shad, Hilsa ilisha (Ham.), in the Narbada River.* By Dr. C. V. Kulkarni, (*Proc. Nat. Inst. of Sciences of India*, 1950, 16).

SCIENCE NOTES AND NEWS

International Conference on the Use of Atomic Energy

An international conference for the exchange of information on the beneficial uses of atomic energy is to be held in Oxford from July 16 to 21. The conference will be devoted to reports by users of radioactive isotopes on the techniques employed and results obtained. Industrial, medical, agricultural and other research uses of isotopes will also be discussed.—

Cosmic Ray Investigations in Antarctica

Australia is planning a new physics station for cosmic ray observations, and other scientific investigations on the shores of the Antarctic Continent. The new station will supplement and extend the scientific and meteorological work now being carried out at Macquarie Island. Two different series of observations on cosmic radiation have been proceeding at Macquarie Island, and the observation post still further south, is expected to increase the value of the work.

Dr. B. Mukerji

The appointment of Dr. B. Mukerji as Director, Central Drug Research Institute, Lucknow, in succession to Sir Edward Mellanby, has been announced.

Zoological Society of Bengal

At the Fifth Annual General Meeting of the Zoological Society of Bengal, held on 6th May, the following Office-bearers were elected for 1951-52: *President*: Prof. H. K. Mookerjee; *Vice-Presidents*: Dr. M. O. T. Iyengar and Dr. Alexander Wolsky; *General Secretary*: Sri. G. K. Chakravarty; *Treasurer*: Sri. M. M. Chakravarty; *Editor*: Sri. J. L. Bhaduri; *Secretary for Foreign Correspondence and Publications*: Dr. S. P. Ray Chaudhuri.

Zoological Society of India: Calcutta Branch

The Annual General Meeting of the Calcutta Branch of the Zoological Society of India was held in Calcutta, on 3rd April 1951, when the following Office-bearers were elected for the year 1951: *Chairman*: Dr. S. L. Hora; *Secretary*: Sri. A. G. K. Menon.

Building Research Congress

More than a thousand delegates have already accepted invitations to attend the Building Re-

search Congress to be held in London in September. They include the Directors of Building Research of ten Commonwealth and continental countries and official representatives of many colonial and other countries.

Royal Institute of Chemistry: Bangalore Section

At the Second Annual Meeting of the Bangalore Section of the Royal Institute of Chemistry, held on 5th April 1951, the following Officers were elected:

Chairman: Prof. K. V. Giri; *Vice-Chairmen*: Mr. H. Shiva Rao and Dr. C. V. Natarajan; *Hon. Treasurer*: Mr. I. S. Patel; *Hon. Secretary*: Dr. T. L. Rama Char.

Science Progress in India: 1938-50

Dr. S. L. Hora, Director, Zoological Survey of India and General Editor, Section of Zoology, writes that the National Institute of Sciences of India has decided to publish a book entitled *Progress of Science in India*, covering the period from 1938-50. Persons interested are requested to pass on the relevant information to the following Sub-Editors, dealing with respective sub-sections as indicated: Dr. N. K. Panikkar, Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, South India (*Fish and Fisheries*); Dr. G. S. Thapar, Department of Zoology, Lucknow University (*Parasitology*); Dr. M. L. Roonwal, Forest Research Institute, Dehra Dun (*Entomology*); and Dr. B. S. Chauhan, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta-12 (*General Zoology*).

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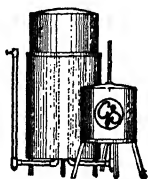


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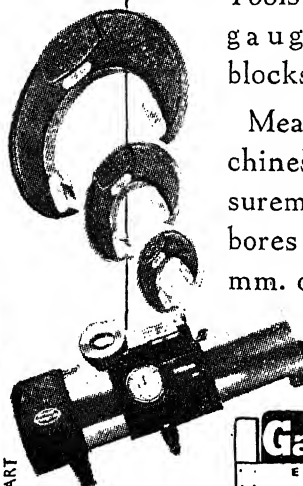
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Current Science

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MEN AND MACHINES

MACHINERY has for many years past occupied a dominant role in human activity, but the nature of the relationship between man and machine has begun to receive serious attention only very recently. It required the stress of World War II to focus attention on the need to fit the equipment to suit the natural characteristics of the average man, because it was discovered that modern weapons and instruments, despite their superior engineering perfection, were not delivering their best on account of the human operator, who remained an essential link in all tasks and procedures. As a result, the problems are beginning to attract the attention of scientists from a wide range of disciplines—anatomists, physiologists, psychologists, engineers, physicists and architects—not to speak also of those who are commercially interested in better production and management.

The series of papers presented at a symposium on HUMAN ENGINEERING under the auspices of the New York Academy of Sciences* gives one an idea of what has been achieved in this

field, while also indicating the possibilities of such studies in future. In the words of Prof. Leonard C. Mead, "Human Engineering is that endeavour which seeks to match human beings with modern machines so that their combined output will be comfortable, safe and more efficient".

The first requirement for this is the acquisition of knowledge which will specify what the normal working man can do *naturally*. It is proposed that this objective can be satisfied by the collection and dissemination of already existent facts, and by the conduct of further research on the working environment, equipment display, machine controls, and system studies. Such information is to be found in the stockpile of knowledge possessed by the engineering profession and by the biological scientists. But, without co-operative effort on the part of these groups, the solution to many present-day problems may only remain one-sided or unsatisfactory. In addition to what may be accomplished by way of modifying equipment, machines, vehicles, and even prosthetic devices in terms of human characteristics, the possibility is also envisaged of modifying the individual in terms of train-

* *Annals of New York Academy of Sciences*, January 31, 1951.

ing procedures, so as to enable him to fit into his working environments.

Quite similar are the aims and objectives of the ERGONOMICS Research Society, a meeting of which held in April 1951, at Birmingham, was an international event. In his Presidential Address to the Society, Sir Ben Lockspieser observed: "The machines of the engineer are becoming more and more complicated, with a corresponding tendency to become more difficult to control. We can no longer afford to leave the human operator to get along as best as he can. The importance of the study of questions such as these is fully realised by the Ergonomics Research Society and is the main reason for its existence."

It would appear that the engineer in the past has tended to rely too much on measures of engineering efficiency expressed as a ratio of work output to input. This has led to too exclusive an attention being paid to the reduction of the physical effort necessary by the operative; also it was too readily believed that any equipment which reduces the physical effort of the operative inevitably increases output and reduces fatigue. But in these matters of human activity at work, regard must be had to the *whole* man, and particularly to the integrated action of his sensorimotor system. The reduction of load placed on the motor system (that is, the reduction of muscular effort) has very often involved an *increase* in the load imposed on the sensory side. The operative is required to pay increasing attention to dials, indicators and controls, to an extent that is liable to overload the sensory side of the ner-

vous system or call for excessively intricate co-ordination of sensory and motor functions. Such a state of affairs, quite as much as sheer muscular effort, induces what is commonly called fatigue—a condition of which there is little scientific understanding—but which must clearly involve both psychological and physiological components.

Clearly enough, Ergonomics has a great part to play in influencing machine design, so as to secure greater ease and comfort for the man at work, while at the same time contributing to higher industrial efficiency through a more complete satisfaction of the needs of his ego.

A reference must be made in this connection to the subject of *Cybernetics*, a term coined by Dr. Wiener and his collaborators to the study of the transmission of signals in a communication system, both in machines and in living organisms. There is a significant parallel between the elements in the functioning of automatic machines and the human nervous system, and the study of cybernetics, it is claimed, is likely to have fruitful applications in many fields, from the design of control mechanisms for artificial limbs to the almost complete mechanisation of industry.

Such studies as the above will no doubt go a long way in reducing to the minimum the drudgery and the fatigue involved in the working of machines. However, it is not improbable that, despite the utmost that can be done in devising the ideal environmental condition for operational work, there would always be behaviour situations which may outrun our ability to handle them.

INTERNATIONAL CONGRESS OF SERICULTURE

THE International Congress of Sericulture is scheduled to be held in the autumn, 1952. Provisionally Kyoto, Japan, has been suggested as a possible venue for the session, and so far no final decision has been taken in this matter.

The Seminar on Silk, which was held on Nandi Hills, considered the advisability of inviting the Congress to hold the 1952 session in India. The event will serve to establish international contacts among our workers on seri-

culture, facilitate personal discussion and in general, galvanise the progress of Sericultural Research and Industry in all their sectors.

The Seminar recommended that the Government of India should be approached with a request that it may take such immediate steps as may be deemed necessary, and extend an invitation to the executive of the Congress in Paris.

M. S.

ZOOGEOGRAPHY*

ZOOGEOGRAPHY is a discipline of Zoological Science which requires for its study a thorough knowledge of animal systematics and behaviour; animal ecology; geography, both past and present; climatology, both past and present; palaeontology and geology. It is, in fact, an endeavour and not a science in its strict sense, for, however advanced our knowledge of zoogeography may be of any particular region, a considerable amount of speculation must continue to exist in zoogeographical treatises. Prof. L. F. de Beaufort, formerly Director of the Zoological Museum and Professor of Zoogeography at Amsterdam, has done a great service to zoology by embodying his vast knowledge and experience of zoogeographical studies in a readable text-book on the subject. So far, mammals and birds have received the greatest attention in animal geography and though sometimes other terrestrial groups of animals also received attention, inland aquatic faunas had been practically ignored. Prof. de Beaufort's book, even in its title, now lays an emphasis on inland waters which is a welcome departure from earlier works and gives a proper perspective to the subject.

In a short preface, the author thus defines the scope of the work: "Zoogeography of the land and of inland waters as discussed in this book, is principally historic zoogeography, that is to say that the factors influencing present land and freshwater distribution have mostly been effective in the past. But, as in all sciences built on history, such as palaeogeography and phylogeny, much is hypothesis, and ever since its infancy historic zoogeography has been looked upon with misgiving by many zoologists. The fault lies with those zoogeographers who have been too rash in building land bridges over oceans or sinking whole continents into the depths of the sea without giving thought to the geological possibilities of such catastrophes."

The greatest fascination of zoogeography lies in an endeavour "to explain the present from the past, or, *vice versa*, to reconstruct the past from the present". Though it may seem simple, it is a very painstaking task. For instance, even the present distribution of a species depends on (i) the age of the species, the older the species

the greater is likely to be the range of its distribution, (ii) the possibilities of its dispersal depending on ecological factors, both biological and physical and (iii) the possibilities of its dispersal in the past depending on palaeoclimates and palaeogeographical features of the country. It is very rightly stated by the author that to build the future edifice of zoogeographical science, one should look to genera or species specialists, for only they can provide the reliable data of distribution through a correct appreciation of speciation.

The author has made it clear and the fact is worth remembering by all zoogeographers that the dispersal of land and freshwater animals are governed by different factors, for many land animals will be able to use a narrow ridge rising out of the sea for crossing from one island to another whereas the same will not be possible in the case of freshwater animals, which will have to wait till the river systems of the two islands become connected.

"Progress in the dispersal of the freshwater fauna will thus be slower than that of land animals, and this difference in time may sometimes help us to form an opinion about the age of the connection."

There is an unlimited wealth of information for zoologists of the different parts of the world in the various chapters dealing with the Holarctic Region, the British Isles, the Oriental Region, the Ethiopian Region, Madagascar and the neighbouring islands, Neogaea, Notogaea and the Celebes, the Moluccas, and the Lesser Sunda Islands. All groups of animals have been given due attention and for the specialist it provides a very useful review of the knowledge upto 1947 or thereabouts.

The utility of this work would have been greatly increased if the author had paid some attention to the rate of speciation in various groups of animals under different ecological conditions. For instance, the author refers to the Malayan element in the fauna of Peninsular India and explains the discontinuous distribution of this fauna on the formation of the Deccan traps in the intervening areas. Taking the isolated fauna as a whole, it can safely be said that in the main the terrestrial isolates migrated during the pluvial periods of the Pleistocene and that the aquatic fauna may have been migrating during the Miocene and Pliocene also. The very highly specialised forms seem to have evolved and spread not earlier than the Pliocene. The formation of the Deccan traps, on the other hand, is stated to have commenced

* *Zoogeography of the Land and Inland Waters*, by Beaufort, L. F. de. (Text-Books of Animal Biology Series). Pp. viii x 208. Text-Figs. 10. (Messrs. Sidgwick and Jackson Limited, London), 1951, Price 30s. net.

in the late Cretaceous and ended in the early Eocene.

Thus there can be no effect of the latter on the distribution of Malayan element in the fauna of Peninsular India. The Symposium on the Satpura Hypothesis, organised by the National Institute of Sciences of India, seems to have escaped the attention of the author. More data have recently been obtained in favour of the Satpura Hypothesis. The palæontological evidence with regard to the age of the genus *Thynnichthys* Bleeker as Eocene would seem to require a thorough checking.

It must be an oversight on the part of the author to state on page 36 that the "Cobitidae

are restricted to Europe and Asia" when he includes *Nemachilus* among the African fauna on page 103. The work is so closely packed with diversified material that such mistakes are likely to go undetected.

A useful bibliography of 132 references is included at the end of the work and there is a detailed index of 16 pages. The book is of a handy size, beautifully printed and got up. The Editor of the series, Prof. H. Munro Fox, the author and the publishers are to be congratulated on bringing out such a meritorious work of reference.

S. L. HORA.

INDIAN VETERINARY RESEARCH INSTITUTE—DIAMOND JUBILEE

THE Diamond Jubilee Celebration of the Indian Veterinary Research Institute, which was held on 11th March 1951, marks the culmination of 60 years of its useful service to the country. Inaugurating the function, the Hon'ble Shri. K. M. Munshi, Minister for Food and Agriculture. Inaugurating the function, the Hon'ble

"India has one of the most important livestock industries of the world whose actual as well as potential value is considerable. She possesses 175 million cattle and buffaloes amounting to a quarter of the world's bovine population, in addition to millions of sheep, goats, poultry and other animals. Yet, the per capita production and consumption of milk in

the country is, perhaps, the lowest in the world. It is said that this is due to adverse environmental conditions. We might therefore look to the I.V.R.I. and the Animal Husbandry Wing for improving these conditions so that the country can make full use of its livestock population. Effort in one direction alone will not be sufficient; what is required is a multi-pronged attack on the complicated problems. Breeding, proper management, feeding of livestock and disease control must be tackled in one comprehensive scheme which can no doubt be linked with the Grow More Food Campaign ultimately."

LADY TATA MEMORIAL TRUST SCHOLARSHIPS AND GRANTS FOR THE YEAR 1951-52

THE Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1951, the awards of Scholarships and Grants for the year 1951-52.

The International Awards of varying amounts (totalling £3,600) for research in diseases of the blood with special reference to Leucaemias are made to Doctors Pascou Atanasiu (France), J. Bichel (Denmark), George Discombe (England), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), Henri P. L. Febvre (France), Niels M. G. Harboe (Denmark), Charles Oberling

(France), Gunther Schallock (Germany), J. B. G. Dausset (France), C. C. Ungley (England), and A. R. Gopal-Ayengar (India).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. Samavedam Srinivasa Sriramacharyulu (Andhra), Gangagobinda Bhattacharya (Calcutta), Madhav Vinayak Patvardhan (Coonoor), Anant Vithal Sunthakar (Bombay), and Dr. (Miss) Smitha Popatlal Bharani (Bombay) and Miss Kamala Ramaswamy (Bombay).

SEMINAR ON SILK

FOR the first time in the history of Sericulture in India, a Seminar on Silk covering every aspect of the industry, was organised by Janab Shamsuddin Khan, the energetic Director of Sericulture in Mysore, under the inspiring and enlightened patronage of the Government of Mysore, who have taken a keen and active interest in the development of the industry in the State. The Seminar was held in the serene and picturesque environs of the Nandi Hills and lasted for five days (14th to 18th June). Delegates from the neighbouring silk-producing States, Madras and Bombay, representing Sericulture and Industry, participated in the proceedings of the Seminar. An instructive exhibition which was organised specially for the Seminar, served to highlight and pinpoint in a vivid and striking manner the pressing problems of the Silk Industry awaiting solution.

It is particularly appropriate that the first Seminar on Silk should be held in the State of Mysore which is responsible for 60-70 per cent. of the India's production of silk. Her silk is distinguished for its higher tensile strength, superior lustre and durability. During World War II, Mysore Silk, on account of its tensile strength, was chosen for the manufacture of parachute fabrics. There has been a harmonious and balanced development of the industry in all its sectors in Mysore. Mysore has led the rest of India in the development of sericulture. The pre-eminent position which Mysore holds to-day in the field of silk, is largely due to the pioneering work carried out by *Rajasevaprakashta* Sri. Navaratna Rama Rao, Retired Director of Industries and Commerce and Vice-Chairman of the Central Silk Board, who may be considered the Patriarch of the Modern Silk Industry in India. It has been a matter of great satisfaction that the Director of the Seminar, Janab Shamsuddin Khan, was able to secure the inspiring presence of Sri. N. Rama Rao during the Seminar and induce him to guide the deliberations of one of the important groups.

The discussions of the Seminar were held under five groups:—*Group I: Moriculture*—Sericulture and Seed Supply under the Chairmanship of Sri. N. Rama Rao; *Group II: Silk Reeling—Charka and Filatures*—Silk Conditioning and Testing, Spun Silk Manufacture and Utilisation of Bye-Products, under the Chairmanship of Sri. M. A. Srinivasan; *Group III: Silk Throwing (Handloom and Powerloom)*—Dyeing, De-Gumming and Silk Weaving, under the guidance of Sri. P. Subbarama Chetty;

Group IV: Research and Education, under the Chairmanship of Prof. M. S. Thacker; and *Group V: Finance, Marketing and Co-operation*, under the guidance of *Rajamantrapravina* Sri. A. V. Ramanathan.

The Indian Silk Industry is, in many respects, comparable to that of Lac. Both occupy a vital position in the agricultural and rural economy of our country. Both have been affected by the uncertainty of crops, the consequent violent fluctuations in the market and in recent years, competition from synthetic substitutes. These vicissitudes have been responsible for the economic instability which characterises these two of her important industries. In the case of silk, Japan has, for years, been our successful competitor. Price of Japanese silk imported into India is only half the cost at which our silk could be sold in our markets. Japanese silk, in some respects, is of a superior quality.

To-day, India produces only a quarter of her requirements; to attain a state of peace-time self-sufficiency, it has been estimated that the country will have to produce ten million pounds of silk valued at 30 crores of rupees. An industry of this economic magnitude and vital importance, is naturally entitled to the active and sympathetic support of the Government, if it should attain the same state of economic efficiency and technological supremacy which characterise the Japanese silk industry to-day.

In the course of the discussions held in the several groups of the Seminar, there has been an encouraging unanimity of opinion, that the remedy to the longstanding and almost chronic disabilities of the industry, lies in planned scientific research, both fundamental and applied. Sri. Navarathna Rama Rao declared that for improving and stabilising the silk industry, India must produce the necessary knowledge in her own laboratories, and added that it offends our self-respect as a free nation to be conscious that we have to depend upon other nations for such knowledge. So far as the interests of Lac are concerned, the Indian Lac Research Institute which was started in 1930, has been trying to create new knowledge which has gone a long way in stabilising this industry. Other commodities like cotton, cocoanut, coffee, tea, etc., are having their own laboratories. Silk, it is hoped, will soon have a Central Research Institute, whose early creation will help to solve the many fascinating and urgent problems and thereby establish a stable and prosperous silk industry in India.

M. S.

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THE MAGNETO-OPTIC CONSTANTS OF SODIUM BROMIDE

THE Faraday rotation in a single crystal of sodium bromide of 1.30 mm. thickness has been measured for the first time using a magnetic field of 15,400 Oersted. The magneto-optic constants have been evaluated using the dispersion data available in Landolt and Bornstein Tables. The Verdet constant V has the values 0.0621 and 0.123 minutes per cm. per Oersted for the wavelengths $\lambda 5461$ and $\lambda 4358$, while the corresponding values of the magneto-optic anomaly γ are 0.86 and 0.88 respectively. The estimated accuracy is about 2 per cent. It is interesting to note that for sodium chloride V_{5461} is 0.0410 and γ is 0.91.

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FARADAY EFFECT AND BIREFRINGENCE

WHEN plane polarised light is incident on a birefringent crystal placed in a magnetic field with the electric vector parallel to one of the principal planes of vibration of the crystal, the emergent light is, in general, elliptically polarised. The major axis of the emergent ellipse is inclined at an angle ψ to the plane of vibration of the incident light, which is given by the equation,¹

$$\tan 2\psi = \frac{\sin 2\gamma \sin \Delta}{\cos^2 2\gamma + \sin^2 2\gamma \cos \Delta'}$$

where

$\Delta = \Delta_0 t = t\sqrt{\delta_0^2 + (\rho_0)^2}$ and $\tan 2\gamma = 2\rho_0/\delta_0$.
 Δ_0 is the relative phase retardation per unit length, δ_0 the phase retardation when there is no magnetic field, ρ the rotation per unit length when there is no birefringence and t is the thickness of the specimen.

It can be shown by suitable algebraic manipulation that, when δ_0 is small, $2\psi = 2\rho (1 - \delta^2/3!)$, where $\rho = \rho_0 t$ and $\delta = \delta_0 t$; and when $2\rho/\delta$ is small, $\tan 2\psi = (2\rho \sin \Delta)/\delta$. As it is easy to measure ψ and ρ with the aid of a half shade, these formulæ would prove extremely useful in the determination of the photoelastic constants of isotropic solids. One measures ρ the rotation for a particular value of the magnetic field when the solid is not strained, and again ψ the rotation with the same field and a known applied stress. Then δ can be easily evaluated from the last two equations. As 2ρ is, in general, small, the two equations cover the range of values of δ usually met with.

The authors' thanks are due to Prof. R. S. Krishnan for the kind interest he showed in this investigation.

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May 20, 1951.

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UNIT CELL AND SPACE GROUP OF BARIUM CHLORATE MONOHYDRATE

FROM a saturated aqueous solution, barium chlorate crystallises at room temperature in the form of needles with one molecule of water of crystallisation. Morphological studies¹ show the crystal class to be C_{2h} with the c -axis as the needle axis.

Rotation and oscillation photographs about the three axes gave the following values for the unit cell dimensions:—

$$a = 8.9 \text{ \AA}, \quad b = 7.8 \text{ \AA}, \quad c = 9.3 \text{ \AA}.$$

More accurate values of cell dimensions calculated from high order reflections $h00$, $0k0$ and $00l$ in Weissenberg photographs are

$$a = 8.86 \pm 0.02 \text{ \AA} \quad b = 7.80 \pm 0.02 \text{ \AA}$$

$$c = 9.35 \pm 0.02 \text{ \AA} \quad \beta = 94^\circ \pm \frac{1}{2}^\circ$$

giving the axial ratio $a : b : c = 1.14 : 1 : 1.20$. These values for $a : b : c$ and for the angle β agree well with the values got from morphological studies, which are $a : b : c = 1.142 : 1 : 1.198$ and $\beta = 93^\circ 34'$. The fact that the intensities of the reflections hkl and $\bar{h}\bar{k}l$ are equal confirm the result of the morphological studies that the symmetry is monoclinic. Taking the density to be 3.18 ,² the number of molecules per unit cell comes out to be 3.84 which is very nearly four.

Zero level and first level equi-inclination Weissenberg photographs about the c -axis re-

vealed the following extinctions: $hk0$ is absent if $h + k$ is odd and hkl is absent if $h + k + l$ is odd respectively. The first set of extinctions is only a special case of the second when l is zero. This result indicates that the above unit cell is body centred.

Zero level Weissenberg photographs about the b -axis showed that $h0l$ reflection is absent if either h or l is odd. This indicates the presence of a (010) glide plane with glide component $a/2$ or $c/2$. The a -glide and the c -glide are equivalent because of the body centering.

Thus the only possible space group for barium chlorate monohydrate is $I2/c$ ($I2/a$, $I2_1/a$, $I2_1/c$). The b -axis of the unit cell is either a screw axis or a rotation axis depending on the choice of origin; and the direction of glide depends on the position of the glide plane.

By choosing a different set of axes a' , b' , c' given by the transformation,³

$$\begin{vmatrix} a' \\ b' \\ c' \end{vmatrix} = \begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} \begin{vmatrix} a \\ b \\ c \end{vmatrix}$$

we can change the body centered lattice to a c -face centered lattice, which transforms the space group into $C2/c$, the standard form given in the International Tables. In this case, the cell constants are $a' = 13.27 \text{ \AA}$, $b' = b = 7.80 \text{ \AA}$, $c' = c = 9.35 \text{ \AA}$, $\beta' = 41^\circ 46'$. The new unit cell has the same volume as the body centered one and hence contains four molecules per unit cell.

In conformity with the convention that those axes are to be chosen for which β is nearest to 90° , we prefer the body centered unit cell and assign the crystal to the space group $C_{2h}^6 - C2/c$ in the particular configuration $I2/c$.

I wish to express my gratitude to Prof. R. S. Krishnan for his kind interest and encouragement and to Dr. G. N. Ramachandran for suggesting the problem and his guidance and help.

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THE AMINO-ACIDS AND AMIDES OF FRESH AND WITHERED TEA-LEAF

DURING withering of tea leaves, the first process in the manufacture of black tea, marked

chemical changes take place, including an appreciable protein breakdown and a corresponding increase in the water-soluble nitrogen. These changes are clearly shown by paper chromatography.

Whatman No. 1 Sheets, 22" \times 18", have been used, employing the descending technique. Full details of apparatus and solvents have been previously described (Roberts and Wood).¹ Amino-acids are detected by spraying with ninhydrin (0.1% in *n*-butanol).

The diagram below gives the pattern of spots obtained with expressed juice from withered leaf. The identifications were made in the first place by reference to published R_f values and maps for pure amino-acids when run individually (Consden, Gordon and Martin,² Steward and Thompson,³ Proom and Woiwod,⁴ Govindarajan and Sreenivasaya⁵). Confirmation in most cases was obtained by observation of the positions taken up on the chromatogram by added amino-acids. Colour reactions such as those obtained with tyrosine and proline gave further confirmatory evidence, as did the behaviour of amides on hydrolysis.

Owing to the autoxidation, under alkaline conditions, of polyphenols (which are subsequently detected on the same chromatogram) no ammonia could be added in the phenol run, thus affecting separation of the basic amino-acids. Although lysine could be identified, arginine and histidine both travelled to the same position on the chromatogram and have not been identified individually in the juice.

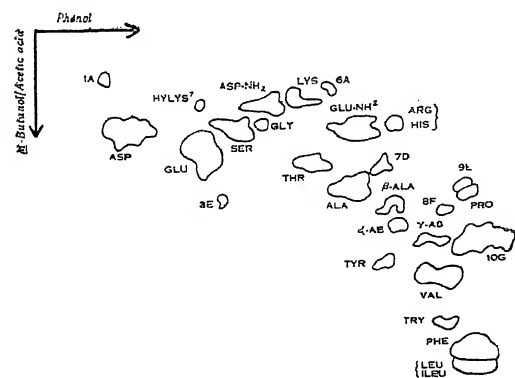


FIG. 1. Abbreviations for individual amino-acids are according to Brand and Edsall,⁷ β -Alanine, α -amino, butyric acid and γ -aminobutyric acid are abbreviated to β -ALA, α -AB and γ -AB respectively. Unidentified substances are marked 1A, 3E, GA, 7D, 8F, 9E and 10G.

Glycine and α -aminobutyric acid are only rarely detected on chromatograms; hydroxy-proline has not as yet been detected. We have as yet

no information concerning the sulphur-containing amino-acids, but all other naturally occurring amino-acids are apparently present in tea-leaf juice if a rather tentative identification of hydroxylysine be accepted. It is of interest that β -alanine and γ -amino-butyric acid are probable normal components of both fresh and withered tea-leaf.

The chromatogram shows several unidentified spots which apparently do not correspond with any of the known amino-acids. One of these spots, 10G, is the strongest spot on the chromatogram and corresponds with what Consden and Gordon⁶ believed to be a mono-ester of glutamic acid. The nature of this substance is under study at present.

The effect of withering on the contents of free amino-acids and amides of tea-leaf is given in Table I. There is a general increase in all amino-acids and amides as a result of withering, but the unidentified substances in general are unaffected or show a decrease.

TABLE I

Substance reacting with ninhydrin	Intensity of spot	
	Fresh leaf	Withered leaf
1A	..	1
Aspartic acid	..	3
3E	..	1
Glutamic acid	..	4
Hydroxylysine?	..	trace
Serine	..	2
Asparagine	..	0.1
Lysine	..	1
Threonine	..	1
6A	..	nil
Glutamine	..	2
Alanine	..	2
Arginine and Histidine	..	0.1
7D	..	1
β -Alanine	..	0.1
Tyrosine	..	1
8F	..	1
Proline	..	nil
9E	..	1-2
γ -Aminobutyric acid	..	1-2
Valine	..	1
Tryptophan	..	0.1
Leucines and Phenylalanine	..	1
10G	..	10

The figures 1 to 10 indicate the relative intensities of the spots.

It will be observed that both in the fresh and withered leaf, aspartic and glutamic acids are the most abundant of the amino-acids occurring.

The table above gives amino-acid contents in shoots consisting of the two terminal leaves and bud. The distribution is not the same in all

parts of the shoot and it has been found that the stem is particularly rich in glutamine and substance 10G and relatively poorer in amino-acids.

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EFFECT OF MILLING ON THE THIAMINE AND PHYTIC ACID CONTENT OF RICE

THE F.A.O. Nutrition Committee¹ for South and East Asia recommended at its Baguio meeting in 1948 that a thiamine content of 1.8 micrograms per gram should be regarded as a minimum standard for milled rice. The thiamine content of rice being itself important is also an index of the degree of retention of other nutrients. Production of rice which retains 1.8 γ per gm. of thiamine may contain more of phytic acid phosphorus. The amount of calcium supplied by rice diets falls short of calcium requirements and this calcium deficiency will be enhanced by controlling the degree of milling with an increased imbalance of Ca:P ratio. The rickets-producing and anti-calcifying action of phytates is quite well established.²

The phosphorus in rice is present both in the organic form as phytic acid and in the inorganic form. McCance and Widdowson³ have estimated the phytic acid content of rice before and after milling. Recently Collumbine⁴ have studied the mineral metabolism of rice diets with reference to the role of organic and inorganic phosphorus. In the present investigation, the phytic acid content, total phosphorus and the relative thiamine content of samples of rice after different grades of polishing were determined. For the estimation of phytic acid, the method of McCance and Widdowson³ was followed. Total phosphorus was estimated by King's modification⁵ of Fiske and Subbarow's procedure.⁶ Thiamine was determined by the method given by Paul Gyorgie.⁷

The results are given in Table I.

TABLE I

Sample	Degree of polishing	Thiamine (μ g./g.)	Phytic acid P (mg./100g.)	Total P (mg./100 g.)	% of Phytic acid, P of total P
I	Unpolished	3.60	324	348	92.9
	4% polished	3.10	180	238	75.6
	7.5% polished	1.80	120	181	66.3
	13.1% polished	1.14	107	124	86.3
II	Unpolished	2.60	224	266	84.1
	6% polished	2.20	161	190	84.8
	12% polished	1.30	70	135	51.8
	18% polished	0.60	66	110	60.9

The percentage loss of thiamine and phosphorus with the degree of milling is given in Table II.

TABLE II

Sample	Degree of polishing	% Loss of thiamine	% Loss of phytic acid P
I	4%	13.8	49.4
	7.5%	50.0	62.96
	13.1%	68.32	67.0
II	6%	15.38	37.1
	12%	50.0	68.7
	17%	76.9	70.70

Table II shows that in the initial stages of milling there is a greater percentage of loss of phytic acid phosphorus than that of thiamine. So it seems to be advisable to have a certain degree of milling to remove part of the phosphorus. With 6 per cent. of polishing there is about 15 per cent. loss of thiamine and 40 per cent. loss of phytic acid P, whereas with about 12 per cent. the thiamine loss is considerable. Full details of the investigation will be published elsewhere.

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ELECTRO-DEPOSITION OF SILVER-LEAD AND COPPER-ZINC ALLOYS FROM CYANIDE-FREE BATHS

SILVER-LEAD: An alloy of silver with 3 to 5 per cent. lead is an excellent bearing metal that can carry heavy bearing loads and is also useful from the view-point of corrosion-resistance. Very little work has been reported on the electro-deposition of this alloy. Mathers and Johnson¹ and Faust and Thomas² have obtained satisfactory deposits from silver cyanide-plumbite and silver cyanide-tartrate baths respectively, but not from cyanide-free baths of the fluosilicate and nitrate-tartrate type.¹

Rama Char and Sadagopachari³ have shown that the silver iodide bath for the electro-deposition of silver (on copper) is quite comparable to the cyanide bath used in the electroplating industry. Silver-lead alloys can be electro-deposited on copper from an iodide bath prepared by dissolving silver iodide and lead acetate in potassium iodide, using silver and lead anodes. With a solution of the composition: Ag(g/L)—1 to 10, Pb (g/L)—20, and KI(g/L)—900, c.d.—0.4 amp/dm² and temp.—26° C., an alloy of widely varying composition, including the bearing alloy low in lead, is obtained. The deposits are smooth and adherent, being gray, ivory white to silvery bright in appearance. The silver-lead ratio in the alloy ranges from 12 per cent. Ag—88 per cent. Pb to 99.5 per cent. Ag—0.5 per cent. Pb, with a variation from 1 to 10 g/L in the concentration of Ag. The throwing power of the bath is satisfactory.

COPPER-ZINC: The co-deposition of copper and zinc has been discovered as early as 1841 and brass is perhaps the most widely electro-deposited alloy on a commercial scale. In view of the poisonous nature and comparative instability of the cyanide bath used in industrial brass plating, some attempts have been made to electro-deposit the alloy from cyanide-free baths. Chloride-sulphate baths have been described by Brunel, *et al.*⁴ and Bennett,⁵ sulphate by Jacobs,⁶ Thompson⁷ (with other additions) and Faust,⁸ thiocyanate by Faust,⁸ oxalate by Bechard⁹ and thiosulphate by Gernes and Montillon.¹⁰ So far there has been little success from the industrial point of view.

In previous communications from this laboratory^{11,12} it has been reported that copper salt-ethanolamine baths gives electro-deposits of copper (on steel) which are quite comparable to those obtained from the commercial cyanide bath. The ethanolamines form complexes with zinc salts in aqueous solutions,¹³ but unlike the

copper complex, a clear zinc salt-triethanolamine solution can be obtained by adding ammonia instead of excess amine. A solution containing 20 g/L zinc sulphate, 60 c.c./L triethanolamine and 55 c.c./L ammonia (24 per cent.) gives satisfactory electro-deposits of zinc on steel in the c.d. range 0.24 to 0.80 amp/dm.² By adding copper sulphate, the resulting copper salt-zinc salt-triethanolamine solution can be used for the co-deposition of copper and zinc on steel, with brass anodes, giving smooth and adherent deposits of brass of widely varying copper-zinc ratio. The throwing power of the solution is satisfactory. The experimental conditions are: copper sulphate—5, 10 and 15 g/L; zinc sulphate, triethanolamine and ammonia—same as for zinc deposition; c.d.—0.6 amp/dm², voltage—1.7 to 2.2 volts, pH 9.8 to 10.0, temp.—24° C. and time of deposition—25 mins. The deposit is whitish, yellow to red in appearance and the composition is Cu per cent.—29, 60 and 68, Zn per cent.—71, 40 and 32 respectively at the 3 concentrations of copper sulphate.

Our thanks are due to the Head of the General Chemistry Section for giving facilities and taking interest in the work.

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DIFFERENCES IN THE SENSITIVITY OF CHOLERAGENIC STRAINS OF *VIBRIO CHOLERAE* TO THE ACTION OF DIFFERENT ANTICHOLERIC THERAPEUTIC AGENTS

DURING the course of laboratory investigations on the chemotherapy of cholera with indigenous plant material, a significant difference in the relative sensitivity of the Inaba and Ogawa strains of *Vibrio cholerae* was observed. In

fact, with Plant No. 26, whereas there was no growth of Inaba by the deep trench method, the Ogawa strain flourished moderately luxuriantly.

To study any possible antigen-drug relationship, formosulphathiazole and sulphaguanidine, the two sulpha drugs reported to be of value in the treatment of cholera¹⁻⁴ were selected and their *in vitro* and *in vivo* action on the two cholera strains determined by procedures which have already been reported.¹ In addition, the "mouse faecal suspension test"⁵ was also included in this study.

Whereas *in vitro* 35 mg. of formosulphathiazole was completely vibriocidal (complete absence of vibrios in the test mixture after 48 hours incubation at 37° C.) and 25 mg. vibriostatic to the Inaba strain, similar action with the Ogawa strain was manifest at 45 mg. and 30-35 mg. levels respectively. Even in as high a concentration as 700 mg. sulphaguanidine was not vibriocidal. Concentrations of this drug ranging from 425-450 mg. and 475-500 mg. were, however, vibriostatic to the Inaba and Ogawa types respectively. These observations indicate the higher susceptibility of the Inaba strain of *Vibrio cholerae* to both types of drug action.

Sets of mice were fed with formosulphathiazole and sulphaguanidine for three consecutive days (dosage: 3 gm. per Kilo per day) and thereafter faecal samples collected at the end of the first, second, third and fourth day. Serial dilutions in peptone water of the sterilised "faecal drug suspension" were titrated against inocula of different sizes of the two strains of *Vibrio cholerae*. Whereas formosulphathiazole (mouse faecal) suspensions were completely vibriocidal to Inaba type in 1:160 dilution, similar action to the Ogawa type was manifested only at 1:40 dilution. The vibriostatic action was also more marked with the Inaba type. The antibacterial activity of sulphaguanidine was of a much lower order, with no vibriocidal action, again indicating a clear-cut difference in the relative sensitivity of the two strains to the two drugs under examination.

The results of *in vivo* mouse protection tests further confirmed the above observations. Whereas 150 mg. of formosulphathiazole, administered intraperitoneally (dosage schedule: 30 mg. per day), gave 70 per cent. protection with the Inaba type, only 50 per cent. of mice, receiving the same dose of 2 M.L.D. (4,000 million cells) of the Ogawa type, survived. Sulphaguanidine under identical conditions, given in half the above-mentioned doses, failed to protect mice with 2 M.L.D. infection. With

1 M.L.D., however, the relative survival ratio (Inaba to Ogawa) was 70 per cent. to 50 per cent. These observations again bring out the higher resistance of the Ogawa type of cholera vibrio to anticholeric drugs.

Recorded data^{6,7} indicate that although during epidemics the Inaba and Ogawa types of *Vibrio cholerae* co-exist, their relative prevalence, nevertheless, varies from place to place and from year to year. Wide variations in the experimental results of clinical investigations on different alleged anticholeric therapeutic agents have been reported from the endemic areas of cholera—the Gangetic delta in the East and that of Cauvery in the South. The studies reported here emphasise the need for bacteriological type interpretation of the available clinical data in therapeutic investigations on cholera.

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NITROPHENYL ALKYL SULPHIDES, SULPHOXIDES AND SULPHONES

IN view of the known antibacterial activity of certain sulphones, the synthesis of *p*-nitrophenyl β -dichloroacetamido- β -hydroxyethylsulphone, a sulphone analogue of chloromycetin, has been undertaken. Some of the compounds prepared during the course of its synthesis exhibit high antibacterial activity against several organisms. The following compounds which have so far been prepared are derivatives of *p*-nitrothiophenol, but for comparison with the more active series, a few derivatives of *o*-nitrothiophenol and *p*-nitrophenol were also prepared:—*p*-nitrophenyl β -hydroxyethyl sulphoxide, m.p. 124°; *p*-nitrophenyl β -hydroxyethyl sulphone, m.p. 125°; *p*-aminophenyl β -hydroxyethyl sulphide, b.p. 190° (bath temp.)/15 mm.; 2:6-diiodo-4-nitrophenylthioglycolic acid, m.p. 112° (dec.); *p*-nitrophenyl carboxymethyl sulphoxide, m.p. 141°; *p*-nitrophenyl

carboxymethyl sulphone, m.p. 167°; *p*-nitrophenyl carbomethoxymethyl sulphone, m.p. 126°; *p*-nitrophenyl α -bromo- α -carbomethoxymethyl sulphone, m.p. 131°; *p*-nitrophenyl bromomethyl sulphone, m.p. 164°; *p*-nitrophenyl dibromomethyl sulphone, m.p. 170°; *p*-nitrophenyl 2:3-dihydroxypropyl sulphide, m.p. 93.5°.

The general method of synthesis of the compounds consists in the reaction of the sodium salts of the appropriate thiophenols and phenols with ethylene chlorhydrin or glycerol- α -monochlorhydrin or with chloracetic acid in alcoholic or aqueous solution. The sulphides were oxidized by treatment with hydrogen peroxide in acetic acid to the corresponding sulfoxides and sulphones. Reduction of the nitro compounds to the corresponding amines was effected in alcoholic solution by hydrogen in presence of Raney nickel. 2:6-Diiodo-4-nitrophenylthioglycolic acid was prepared by iodination of *p*-nitrophenylthioglycolic acid with iodine monochloride in acetic acid. Bromination of *p*-nitrophenyl carboxymethyl sulphone under various conditions always gave *p*-nitrophenyl dibromomethyl sulphone, whereas bromination of *p*-nitrophenyl carbomethoxymethyl sulphone yielded the desired *p*-nitrophenyl α -bromo- α -carbomethoxymethyl sulphone. Treatment of the latter compound with aqueous alkali gave *p*-nitrophenyl bromomethyl sulphone by simultaneous hydrolysis and decarboxylation.

The antibacterial activity of these compounds is being reported upon separately by Prof. B. V. Bhide and Mr. P. Y. Dighe.

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May 4, 1951.

ULTRA-MICRO PAPYROGRAPHY

PARTITION chromatography (papyrography) with filter paper strips and sheets, first introduced by Consden, *et al.*¹, was carried out by the capillary descent of the solvent. Horne and Pollard² and Williams and Kirby³ brought about a considerable simplification of the technique and apparatus by adopting the capillary ascent of the solvent. The method of Rockland and Dunn⁴ represents a micro adaptation of the one-dimensional strip method which also involves capillary ascent. This micro-method was critically studied by Govindarajan and Sreenivasaya⁵ and has since been successfully applied to a variety of biochemical problems.

Usually spotting is carried out with 2 to 4 μ l of the solution which contains about 5 to 15 μ g of the substance, as in the case of amino acids and sugars. For a determination of the relative concentration of the various forms of penicillins in a sample of fermented beer, one usually employs 5 units of the antibiotic.⁶ A reduction in this quantity was effected by Karnovsky and Johnson⁷ who worked with 1-2 units.

In certain types of investigation, *e.g.*, the determination of (1) penicillin-producing capacity of single spores of fungi, (2) penicillin levels in physiological fluids and tissues after injection and (3) allied problems, we were faced with the problem of detecting and estimating smaller quantities of the antibiotic. It was felt that, by using sewing thread of cotton as the cellulosic support in place of the strip of filter-paper, this object of determining the antibiotic in ultra micro quantities might be achieved.

Sewing thread, after successive treatments with (1) benzene, (2) hot water, (3) takadiastase, was washed with water, alcohol and finally with ether. The thread was then impregnated with M/15 phosphate buffer pH 6.2 and air dried. The thread, thus treated (about 400 mm. in length) was used for each experiment. For "ascending" papyrography, the thread (T) (see Fig. 1) was tied to a glass

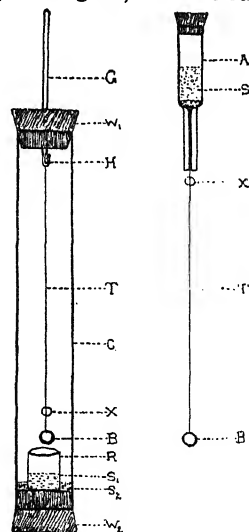


FIG. 1

hook (H) drawn at the end of a glass rod (G) held by a wooden cork (W_1). The other end of the thread is suitably weighted by a glass ring or bead (B) which helps to maintain the thread vertically. The thread is spotted with the test solution at a place (X) about 10 mm.

above the glass ring (B) and air dried. The cork-rod-thread (W_1 -G-T) assembly is carefully placed in a chamber (C) consisting of a glass tube (450 mm. \times 35 mm.) which is closed at the other end by means of a wooden cork (W_2) which provides a platform for the receptacle (R) containing the developing solvent (S_1) saturated with water. The chamber (C) is lined with filter paper wetted by the solvent-saturated water (S_2) which helps to facilitate rapid equilibration of the system. After a couple of hours during which equilibrium is attained, the thread is carefully lowered into the developing solvent by pushing down the glass rod (G) so that the spotted portion of the thread is well above (at least 5 mm.) the solvent surface. The capillary ascent of the solvent commences immediately and with a solvent like water-saturated ether, the development is usually complete in about an hour. The cork-rod-thread assembly is then carefully lifted out of the chamber, the thread, air dried and bioautographed by the method described earlier,⁸ employing a suitable organism. In the case of penicillin we have employed *Strep. aureus* for all the bioautographic tests. The results of one such test is figured in Fig. 2.

The method can be adapted for the "descending" development technique. In place of the glass rod (G), an adapter A (see Fig. 1) made of Pyrex tube (10 \times 50 mm.) to which a Pyrex capillary (1.0 mm.) and (50 mm. \times 7 mm.) is fused, is employed. The thread is knotted at one end, passed through the capillary and pulled so that the knot plugs capillary. The thread which is thus held in position, is then weighted by a glass ring (B) at the other end. The spotting of the thread with the test solution is carried out at a place a few millimetres (X) below the end of the capillary. A small quantity of treated absorbent cotton is used for reinforcing the plug. The assembly consisting of the adapter and the weighted thread, is held by a wooden cork (W_1) and is placed in the chamber (C) whose other end is closed by a wooden cork (W_2). No receptacle for the developing solvent is necessary. After equilibration, the solvent is placed in the adapter and closed with a cork. The solvent immediately commences to descend and develop the "papyrogram". If flooding is desired, the "development" is permitted to continue; otherwise the thread is air dried and bioautographed.

It will be seen that the method has been successfully employed for the partitioning of the various penicillins in a fermented beer and in quantities which range between 0.2 — 0.05 units. This ultra micro method is capable of

being employed not only for an assay of other antibiotics but also for vitamins and other

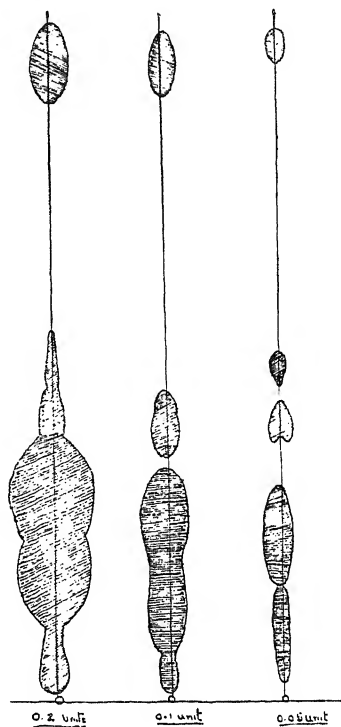


FIG. 2

Penicillium notatum grown on the Basal medium Supplemented with Enzyme-Free Moldy Bran Extract (1.0% solids). Papyrograms were developed on the thread.

Activity tested by Bio-autographic technique using *S. aureus* as test organism. Shaded areas represent clearance zones.

active principles whose presence can be detected by some type of bioautographic technique involving either an inhibition or growth of a suitable test organism. This method is now being further developed in our laboratories.

Our grateful thanks are due to Prof. M. S. Thacker for his kind interest and encouragement.

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Indian Inst. of Science, M. SREENIVASAYA.
Bangalore.

June 10, 1951.

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BIGUANIDO DERIVATIVES OF DIARYL SULFONES AND SULFIDES

THE derivatives of *p-p'*-diaminodiphenyl sulfide and sulphone, 4-nitro-4'-aminodiphenyl sulphide and sulphone are well known for their antibacterial properties.¹⁻³ Diaminodiphenyl sulphone and its derivatives are widely used in the treatment of leprosy.⁴ The biguanido derivatives of these amines have been prepared with a view to studying their pharmacological properties. These compounds were obtained by refluxing the amine hydrochlorides with proper cyanoguanidines in a suitable medium (alcohol, pyridine, etc.), and purified through crystallization from water or dilute alcohol. Some of these compounds have shown very encouraging antitubercular properties in *in vitro* tests.

The melting points of these compounds are recorded below.

R	(R-X-C ₆ H ₄) ₂ S	(R-X-C ₆ H ₄) ₂ SO ₂	R-X-C ₆ H ₄ SC ₆ H ₄ NO ₂	R-X-C ₆ H ₄ SO ₂ -C ₆ H ₄ NO ₂
C ₆ H ₅ -	.. 176°	240°	228°	170°
<i>p</i> -Cl·C ₆ H ₄ -	.. 172°	192°	207-03°	168°
<i>p</i> -Br·C ₆ H ₄ -	.. 166°	189°	178°	158°
<i>p</i> -I·C ₆ H ₄-	.. ..	177°	..	..
<i>p</i> -CH ₃ ·C ₆ H ₄ -	.. 170°	175°	199-200°	124°
<i>p</i> -CH ₃ O·C ₆ H ₄-	.. ..	268°	..	..

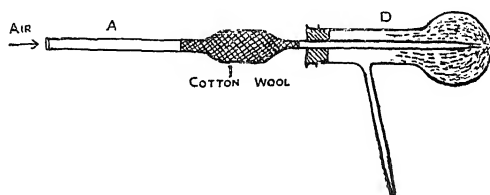
X = -NH-C-NH-C-NH-			
NH		NH	

Attempts to make the bis-cyanamide of *p-p'*-diaminodiphenyl sulphone as an intermediate in the preparation of guanides as well as biguanides have been unsuccessful. Reaction with cyanogen bromide usually gave a resinous product instead of the expected cyanamide. Attempts to make the cyanamide via thiourea also resulted in failure.

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May 14, 1951.

A SIMPLE DEVICE FOR SPRAYING MOULD SPORES FOR SURFACE CULTURES



IN the arrangement shown above a 50 ml. distilling flask serves as a useful spray-gun. 'A', a 25 ml. pipette, the bulb and 4 cm. length of each side of the bulb being packed well with cotton wool, is fitted to the neck of the distilling flask 'D'. A and D are sterilised in an air oven. The spores are mixed with sterile charcoal powder and transferred aseptically to the distilling flask. Air at about ¼ atmos. is blown in through 'A', when the mixture of the charcoal powder and spores gush out through the drawn-out side tube of the flask 'D' and could be sprayed as desired.

The cotton wool packing in 'A' serves as an air filter. The charcoal powder serves as support for the spores and provides a large surface. Chemistry Laboratory, R. KAUSHAL.
Holkar College,
Indore,
April 2, 1951.

DETECTION OF GROUNDNUT OIL IN MUSTARD OIL

FOR the detection of groundnut oil in mustard oil the Bellier's test as modified by Evers,¹ depending on the clouding temperature of an acidified alcoholic saponified solution of the oil, is adaptable for routine work. However, this test, when applied in its entirety, fails to give concordant results with mustard and groundnut oils. It has been found that if the test is further modified in the following manner, results are reproducible:

(a) Using diluted acetic acid in place of Evers' hydrochloric acid (Sp. Gr. 1.16).

(b) Adding a definite extra amount of the acid after exactly neutralising the saponified oil to keep the acidity of the solution uniform.

Test.—One ml. of the oil is saponified completely with 5 ml. of 1.5 N-alcoholic potash by heating over a small flame. Two drops of phenolphthalein indicator are added and the solution is carefully neutralised with 1:1 acetic

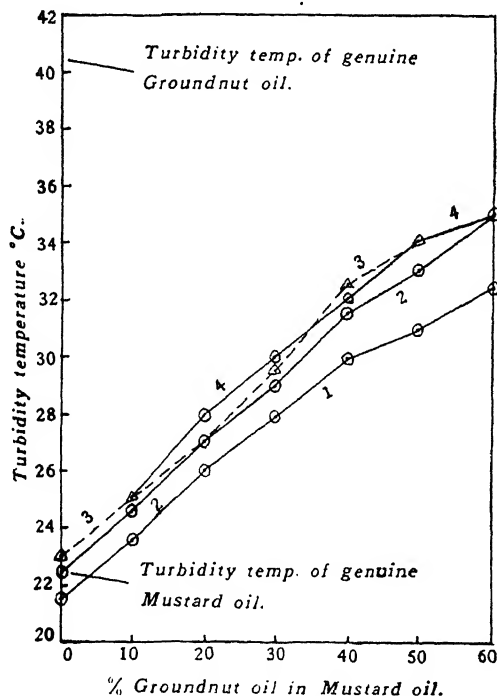
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acid using a 1-ml. pipette graduated to hundredth. When the pink colour is just discharged, a further 0.2 ml. of the acid, measured accurately, is added. The solution is then mixed with 25 ml. of 70 per cent. alcohol, temperature raised to 50°C., and slowly cooled with constant shaking in a water bath maintained at 15°C. When the first sign of cloudiness appears the temperature is noted. This is the turbidity temperature.

By the above test, the turbidity temperatures of some common vegetable oils are found to be: groundnut oil: 40 to 41°C.; mustard oil: 21 to 23.5°C.; coconut oil: 18°C.; linseed oil: 21.5°C.; nigerseed oil (very old sample): 27°C.; sesame oil: 20°C. For mustard oil adulterated with groundnut oil, the turbidity temperature goes over 24°C. depending on the extent of adulteration. Also, presence of the latter will increase the saponification value and lower both the iodine value and the refractive index of mustard oil.

Further, the turbidity temperature of mustard oil increases almost proportionately with the increasing amount of groundnut oil present. The following figure makes this clear:

Rise in the turbidity temperature of mustard oil with gradual addition of groundnut oil.



For every 10 per cent. groundnut oil present, the turbidity temperature of mustard oil is

raised by about 2°C.; thus, it is possible to estimate the amount of groundnut oil present provided a second adulterant is absent. It has been observed that in some cases even an addition of 20 per cent. groundnut oil does not raise the saponification value sufficiently high for the sample to be declared adulterated, but the turbidity temperature is, thereby making it possible to detect the adulteration.

It may, therefore, be presumed that for mustard oil a turbidity temperature of over 24°C. associated with a high saponification value, a low iodine number and a low refractive index gives sufficient evidence of the presence of groundnut oil.

The detailed work will be published elsewhere.

Public Health Laboratory, S. N. MITRA.
Govt. of West Bengal,
March 27, 1951.

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TUBERCULOSTATIC PROPERTIES OF SOME ANTIMALARIAL COMPOUNDS

WHEN our studies of the antibacterial action¹ of the quinoline-substituted guanides (synthesised as possible antimalarials) were extended to include *Myco. tuberculosis*, it was observed that a number of these compounds showed tuberculostatic properties.² Administration of quinine in incipient cases of tuberculosis has also been known to give temporary clinical remissions.³ Hence the following study was undertaken to elucidate whether this effect is due to a definite bacteriostatic action of the drugs on *Myco. tuberculosis* or merely a physiological, non-specific antipyretic action. Quinine and some of the other widely used antimalarials were subjected for their tuberculostatic property and *para*-aminosalicylic acid, a well-known anti-tubercular compound was included for a comparative study.

The simple synthetic medium as defined by Youmans⁴ was chosen for the *in vitro* test. The H.-Rv strain of *Myco. tuberculosis* var. *hominis* obtained from the National Collection of Type Cultures, England, was the test organism.

Table I summarises the tuberculostatic action of the antimalarials at the end of 2 weeks.

A study of the above table indicates that up to 14 days, all the compounds except paludrine show complete inhibitory activity at 10 γ/c.c. level while a faint growth is visible with paludrine at this concentration,

TABLE I

Tuberculostatic properties of some antimalarial compounds (2 weeks incubation)

No.	Compound	Proprietary name	Drug concentration $\mu\text{g./c.c.}$					
			1000	100	10	5	1	0
1	6-Methoxy- α -(5-vinyl-2-quinuclidyl)-4-quinoline methanol (di-hydrochloride)	Quinine dihydrochloride	—	—	—	1+	1+	2+
2	N ₁ - β -chlorophenyl N ₃ -isopropyl diguanide	Paludrine	—	—	\pm	1+	2+	2+
3	7-Chloro-4-(4-diethyl-amino- α -methylamino)-quinoline (diphosphate) [a]	Chloroquine	—	—	—	1+	1+	2+
4	4 (3'-diethylamino-methyl-4-hydroxyanilino)-7-chloroquinoline [a]	Camaquin	—	—	—	1+	1+	2+
5	Para-amino-salicylic acid [b]	Paramisan	—	—	—	—	—	2+

— Complete inhibition; \pm faint growth; 1+ and 2+ various grades of growth; [a] Compounds kindly supplied by Dr. R. K. Anderson of Rockefeller Foundation, Bangalore; [b] Generous supply of Herts Pharmaceuticals, England.

Observation of the amount of growth was continued at weekly intervals and Table II shows the degree of inhibition at the end of 6 weeks.

TABLE II
Tuberculostatic action of antimalarial compounds
(6 weeks incubation)

Compound	Absolute concentration $\mu\text{g./c.c.}$	Critical concentration $\mu\text{g./c.c.}$
Quinine dihydrochloride	100	10
Paludrine ..	100	10
Chloroquin ..	1000	10
Camaquin ..	1000	10
P.A.S. ..	5	1

Absolute concentration was taken to be the lowest concentration giving complete inhibition, while critical concentration was considered to be the lowest concentration $\mu\text{g./c.c.}$ giving more than 50 per cent. inhibition. Table II shows that even at the end of 6 weeks, all the compounds still maintain more than 50 per cent. inhibitory activity at 10 $\mu\text{g./c.c.}$; complete inhibition is exhibited by quinine and paludrine at 100 $\mu\text{g./c.c.}$; by chloroquin and camaquin at 1,000 $\mu\text{g./c.c.}$; while P.A.S. suppresses growth at 5 $\mu\text{g./c.c.}$

The inhibitory action of all these antimalarials was observed to be entirely lost at the end of 12 weeks when the growths in the control as well as in the media containing the

drugs were found to be almost equal; P.A.S. still maintained its suppressive activity.

In a similar *in vitro* experiment, Martin⁵ has demonstrated that Mepacrine, another antimalarial, inhibits the growth of tubercle bacilli in a 1/1000 dilution. Hoggarth and Martin⁶ have also observed that anilino pyrimidine, a chemical type from which paludrine was subsequently evolved possesses *in vivo* activity against tubercular infection of mice though of a slight degree.

We thus find that all the antimalarial compounds tested exhibit definite *in vitro* tuberculostatic property and one of them has been proved to possess slight *in vivo* activity. It is suggested that the slight clinical improvement noticed after administration of antimalarials to incipient cases of tuberculosis might be due to their tuberculostatic action.

Our thanks are due to Dr. K. P. Menon for the helpful suggestions during the course of the experiment.

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Indian Institute of Science, N. N. DE.
Bangalore 3,
May 2, 1951.

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INTER-IONIC RELATIONSHIPS IN
PLANTS AND THEIR SEEDS

It has been shown by Subbiah (1946) and Desai and Subbiah (1951) that the ratio of cations to nitrogen (as nitrate ion) is approxi-

the ratio of cations to anions in all the seeds is practically constant. Further work having a bearing on the above will be reported separately in detail.

The author wishes to thank Dr. S. P. Raychaudhuri, Dr. S. V. Desai and Mr. M. A. Idnani

TABLE I

Cation and anion contents in m.e. per 100 gm. of seed

Seeds	Individual cation content				Individual anion			Total contents of		Cation/anion ratio	
	K ⁺	Ca ⁺⁺	Mg ⁺⁺	Na ⁺	NO ₃ ⁻	H ₂ PO ₄ ⁻	SO ₄ ⁼	Cations	Anions		
CEREALS											
Wheat (Forbes, 1913)*	..	13	3	11	1	118	17	12	28	147	0.19
Wheat (Cooper, 1948)	..	10	2	12	5	123	14	10	29	147	0.20
Corn (Forbes, 1913)	..	9	1	9	2	99	8	10	21	117	0.18
Corn (Cooper, 1948)	..	14	1	9	†	124	12	5	24	141	0.17
Oats (Forbes, 1913)	..	11	4	10	7	121	13	12	32	146	0.22
LEGUMES											
Soyabean (Forbes, 1913)	..	49	11	18	15	450	19	13	93	482	0.19
Navybean (Forbes, 1913)	..	29	10	15	3	254	12	12	57	278	0.20
Cowpeas (Forbes, 1913)	..	36	5	17	7	253	15	16	65	284	0.22
MISCELLANEOUS CROPS											
Mustard (Piesse, <i>et al.</i> , 1880)	..	21	21	23	†	319	24	9	65	352	0.19
Cotton (Cooper, 1948)	..	29	4	30	1	288	22	25	64	345	0.19
Tobacco (Paris, 1920)	..	23	13	28	4	250	12	†	68	262	0.25†

* Refers to the source. † Less than 0.5 m.e. per 100 gm. of seed. ‡ Chloride may not be negligible in this case.

mately constant for each species of plants and this ratio appeared to vary with the pH of the sap for different species. Working on similar lines, Bear (1950) showed that the overall cation-anion relationship in the whole plant can be expressed by the following equation at any given pH value:

$$\frac{K + Ca + Mg + Na}{N + P + S + Cl + Si} = \text{Constant.}$$

Bear (*loc. cit.*) explained this from the electrostatic balance of ions between the inside of the plant and the nutrient substrate. It follows from this that in seeds which are the starting point in the plant growth, the cation-anion ratio should also be constant. To examine this, the data comprising the best available in literature on the composition of different seeds is presented in the following table. In determining the equivalent weight of nitrogen, phosphorus and sulphur, they were calculated as NO₃⁻, H₂PO₄⁻ and SO₄⁼ which are the most commonly absorbed forms. Chloride and silicate are not included here, as they usually occur in negligible proportion.

Considering the diverseness of the sources and the varying methods of analysis employed,

for their interest and encouragement in the preparation of this note.

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Indian Agricultural Research Institute,
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March 15, 1951.

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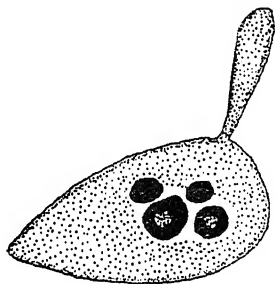
CRITICAL EVIDENCE FOR MITOSIS
IN YEASTS

A NEW yeast mutant having an unequal pair of chromosomes was isolated in this laboratory in 1945.¹ This top yeast is relatively autotrophic,² has lost its power to ferment sugars,³ and excretes considerable amounts of ribo-

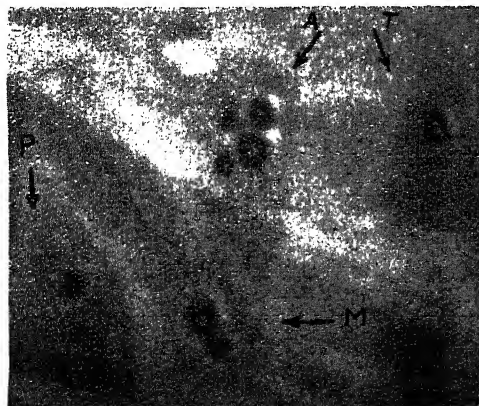
flavin.⁴ Owing to the above characteristics, the strain has been under observation for the past six years.⁵

Critical evidence for the identification of chromosomes is a demonstration of an anaphase in Feulgen preparations. When there is only a single pair of chromosomes having an identical shape it is easy to demonstrate that each splits into two daughter halves but difficult to prove that only one daughter chromosome from each member of the original pair passes on to the bud. The inequality of the chromosome pair in the top yeast makes it ideally suited for a demonstration that each of the chromosomes divides into a pair of chromatids and that the bud and the mother cell get always an unequal pair.

The photomicrograph is of a field from a smear fixed for 20 minutes in osmic vapour, hydrolysed for 6 minutes and stained with Feulgen's leuco-basic-fuchsin. At P is a cell at prophase. The nucleus appears as a clear



unstained area in the centre of which is a chromatin mass. The inequality of the chromosomes is seen in the cell at metaphase (M). The anaphase is characteristic (A, Photo; Fig.).



P. Prophase; M. Metaphase; A. Anaphase; T. Telophase. The length of the cell showing an anaphase is 4.8μ .

The daughter chromosomes form two unequal pairs. The bud of the above cell appears to have reached a considerable size (Fig.). One pair of the daughter chromosomes would pass on to the bud (T, Photo) and thus the chromosome complement shows a fixity as regards their size. For the past six years (cf. illustrations of Subramaniam and Ranganathan¹) the strain has retained its original chromosome constitution. It is this appearance of fixity and stability of the chromosomes that has been considered to be marvellous.⁶ "Indeed it was this picture of precision and unity in the mitotic process which led Roux and Weismann to the conception of the chromosome theory of inheritance" (p. 634). The demonstration of an anaphase in Feulgen preparations should disprove Lindegren and Rafalko's⁷ claim that these may be centrioles and that of Winge and Roberts⁸ that the chromosomes are too small to be counted.

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April 5, 1951.

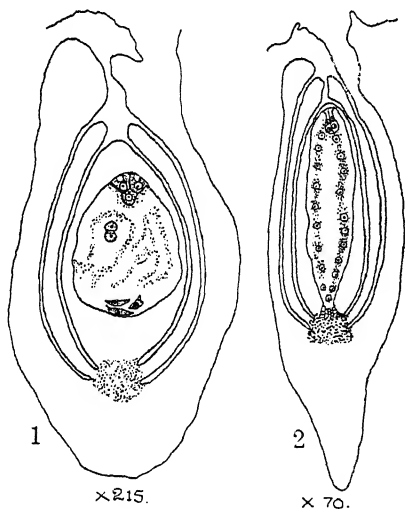
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A NOTE ON THE EMBRYOLOGY OF *DIOSCOREA OPPOSITIFOLIA* L.

Dioscorea oppositifolia L. is a member of the Dioscoreaceæ, and the literature on the embryology of this family has been reviewed by Schnarf.² The young anther is made up of three wall layers external to the tapetum. The tapetal cells are binucleate and are of the glandular type. The endothecium develops fibrillar thickenings. Separation of microspores takes place by cell plate formation and the microsepores are arranged in an isobilateral manner. Occasionally they exhibit a tetrahedral arrangement. The pollen grain at the time of shedding is oval in outline with a pro-

minant tube nucleus and a lenticular generative cell.

The ovary is inferior, trilocular, with a single anatropous crassinucellate bitegmic ovule in each locule attached on the axile placenta. At the chalazal region of the ovule a hypostase-like tissue is present consisting of compactly arranged cells with dense cell contents and prominent nuclei. The archesporium is differentiated in the young nucellar primordium. It divides transversely producing the primary parietal cell and the megaspore mother cell. Megasporogenesis proceeds normally and the development of the embryo-sac follows the *Polygonum* type.¹ The mature embryo sac is oval in outline (Fig. 1). The synergids are



hooked and the egg is pearshaped. As in *Dioscorea villosa*,² one of the synergids persists during the early stages of embryo development. The polars fuse in the centre of the embryo sac. The antipodals are organised as cells and degenerate soon after fertilisation.

After fertilisation the antipodal end of the embryo sac elongates and finally reaches the hypostase-like tissue (Fig. 2). Into this portion the free endosperm nuclei migrate. At a later stage the free nuclear endosperm becomes cellular.

The first division of the fertilised egg is usually transverse, rarely oblique, resulting in a two-celled embryo. In *D. villosa* the fertilised egg divides usually in an oblique manner and sometimes either vertically or transversely. A vertical wall is then laid down in both these cells. Succeeding divisions are irregular and by further development the adult embryo is pro-

duced. The mature embryo is elongated with a terminal cotyledon and a lateral stem tip.

The seed is winged, with a four-layered testa and a tegmen made up of two layers. The cells of the innermost layer of the testa develop characteristic lignified thickenings on their basal and tangential walls.

My sincere thanks are due to Prof. L. N. Rao and Dr. K. Subramanyam for helpful suggestions.

Dept. of Botany,
Central College,
Bangalore,
May 9, 1951.

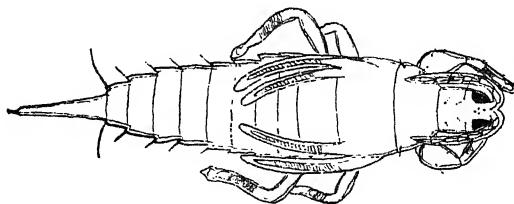
A. NAGARAJA RAO.

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2. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, Berlin, 1931.
3. Smith, P. M., *Bull. Torrey Bot. Cl.*, 1916, **43**, 545-58.

FEMALE PUPA OF *DINOTHRIPS* *SUMATRENSIS* BAGNALL

DESCRIPTION: General colour of the body, brownish yellow; eyes dark. Antennæ eight jointed, setaceous, straight in front of head and bent caudad at the second joint. Joints 3-6 of the same length, narrow at base and broad towards the apex. Sense cones prominent in segments 3-6.

Head as long as broad and round above the eyes with cheeks almost parallel. Eyes black and occupying more than one-thirds the length of the head. Ocelli fairly clear arranged in a triangle. Interocular space larger than the width of an eye. Postocular spine very prominent and more than half the length of the head. Two small spines below and opposite to the inner margin of each eye. Below the latter, in a level with the postocular spine, are two smaller spines. Marginal spines absent. Mouth cone narrow and bluntly pointed.



Female Pupa of *Dinothrips sumatrensis* Bagnall.

Prothorax almost as long as head and slightly shorter than the pterothorax. Prothoracic spines long and pointed, anterolateral, mid-

lateral and posterolateral ones being present. The midlateral spine is the longest of the three. Pterothorax as long as wide and longer than head and thorax put together. Spines lacking.

Legs well differentiated, the forelegs being prominent. Forefemora stout, with two spines one on each border. Tibia curved at base and fringed at the margin. Tarsus with a prominent curved tooth. Mid and hind legs equal, with tibia distinctly fringed. Prominent spines lacking.

Abdomen longer than the head and the thorax put together being broadest at base and gradually narrowing to the posterior extremity. A pair of small lateral spines present one on each side, on each segment, those on segments 3-7 being distinct. Tube long with a few small hairs at the extremity. Wing pads equal, reaching upto the third abdominal segment.

MEASUREMENTS: Total length: 4.3 mm.; Length of Antennæ (in the bent position) .812 mm.; Width of eye 7 μ ; Interocular space 10 μ ; Postocular spine 15 μ ; Length of head .391 mm.; Width across eyes .391 mm.; Length of prothorax .406 mm.; Width of prothorax .768 mm.; Length of pterothorax .914 mm.; Width of pterothorax .37 mm.; Length of abdomen 2.61 mm.; Length of tube .768 mm.; Length of wing pads 1.08 mm.

Loyola College, T. N. ANANTHAKRISHNAN.
Madras,
December 20, 1950.

EXTENSION OF GEOGRAPHIC RANGE OF *PSILORHYNCHUS BALITORA* (HAMILTON)

Psilorhynchus balitora is recorded from Uttar Pradesh for the first time and is an extension in the known range of the species as defined earlier by Day¹ and Hora.² On June 15, 1949, two specimens were found among a collection made from Gomti River, Lucknow, U.P., in association with *Nemachilus zonatus*. At first their detection had escaped notice but the absence of barbels made their separation from the collection easy at the time of detailed examination and a search was started for more specimens. On February 27, 1950, eleven specimens were again captured from the same locality. Six were kept in an aquarium to study their feeding and spawning habits but they did not take well to aquarium conditions and all the specimens died within two days. On June 24, 1950, further 75 specimens were collected at another place, Pipraghat, Lucknow. The specimens are preserved in the Department of Fisheries collection of fishes. Dr. Hora during a discussion

in the meetings of the Zoological Section of the Indian Science Congress held at Bangalore reported that (just when he was leaving for Bangalore) he had received a very young specimen of *Psilorhynchus balitora* collected from Delhi. If more specimens are captured from this locality, a further record of westward extension of the range of *Psilorhynchus balitora* will be established.

Psilorhynchus balitora is generally found on sandy bottoms in clear rapid running streams and at the place of capture of the specimens under report water flows with force as a result of setting a weir although no boulders or rocks exist at these places. The fish were caught by an ordinary scoop net. The standard size of mature individuals varied from 1½" to 2". Our biggest specimen was 2". It is likely *Psilorhynchus balitora* has established at the places of capture as smaller specimens of 1" were captured. The specimens were invariably found in association with *Nemachilus zonatus*. The collected specimens resemble closely to the published figure by Day (*op. cit.*, Fig. No. 86) except slight variations in colouration. The general colour of the fish is palish white with 7 or 8 faint black blotches on the mid-dorsal line and about the same number of irregular smaller blotches along the lateral line. The caudal fin does not have 3 transverse bars as described by Day but has only two black streaks one corresponding to each lobe of the fin. The head is somewhat depressed and mouth is markedly inferior. D 10; A 7 (2/5); V 9 (2/7); P 17 (5-7/10-12); head 5-5½; of total length; scales above lateral line 3. An examination of gut showed sand in large quantities and pieces of algae which were identified as *Ulothrix*, *Horomidium*, *Nitzschia*, and *Gomphonema*. A detailed paper dealing with the ecology of this interesting fish will be contributed later on.

Fisheries Department, B. S. KAUSHIVA.
Uttar Pradesh,
Lucknow,
January 5, 1951.

1. Day, *Fauna of British India, Fishes*, 1889, 1, 244.
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DYNAMICS OF EYE-STRIPE COMPOSITION, BIOMETRICAL RATIOS AND CERTAIN OTHER CHARACTERS DURING PHASE TRANSFORMATION IN THE DESERT LOCUST

THE dynamics of phase-transformation in the first two years of a new or 9th recorded swarming cycle of desert locust, *Schistocerca gregaria*

(Forsk.), which commenced in 1949, have been studied with respect to variation in the eye-stripe composition, sex-ratios, and biometrical ratios of the size of the body-parts, etc. The populations studied are: (i) the incipiently swarming first year's population (about 20,000 per sq. mile) at Kakko in Bikaner District in the Rajputana Desert, in July 1949; and (ii) the second year's swarming population at Ajmer, Rajputana, in June 1950. These two populations are compared to the typically *gregaria* and typically *solitaria* populations studied earlier by Roonwal⁴ (1949) and Roonwal and Nag⁵ (1950). The more important results are briefly given below.

The first year's or 1949 Kakko population was intermediate between the phases *solitaria* and *gregaria*, but closer to the former. The eye-stripe composition was 94 per cent. 6-eye-striped, 5.6 per cent. 7-striped and with one example of a 5-striped individual. This contrasts with 100 per cent. 6-eye-striped individuals in typical swarms, as shown by Roonwal² (1945). For particulars regarding variation in the eye-stripes, see Roonwal^{1,3} (1936, 1947). The ♂ : ♀ sex-ratio was not significantly different from 50 : 50, which is a phase *gregaria* characteristic.

The second year's or 1950 Ajmer population, though in some respects intermediate, was very close to typical *gregaria*.

The body-characters studied were the following: Length of elytron (E), width of elytron (W), length of hind-femur (F), maximum width of head in genal region (C), length of pronotum at the keel (P), and the ratios E/F, F/C, P/C and E/W. It has been found that of all these characters, the head-width (C) is the most phase-sensitive (*vide* also *infra*), and the same applies to the ratios associated with head-width, namely, E/C, F/C and P/C. Dirsh⁶ has also recently reported on the sensitiveness of the ratio F/C. However, while he has rightly taken sex variation into consideration, he does not appear to have taken into account the very real eye-stripe variations, so that his conclusions are possibly statistically vitiated to that extent.

The use of discriminant functions of more than one biometric character as regards the size of the body-parts was critically studied from the statistical point of view. Taking individual characters, C was found to be the most discriminant of all the four characters, namely, E, F, C and P, for both males and females. If more than one character is used for discriminating between the phases, C and P were found to be the best set of characters for males, and

C, F and P the best set of characters for females. The ratios E/C, F/C and P/C discriminate better than E/F probably due to the fact that C is the most discriminant single character.

In 1945, Roonwal² tentatively put forward three hypotheses for the prediction of swarming of the desert locust. These hypotheses have now been re-examined and their soundness has been statistically established.

Full results of this investigation will be published elsewhere.

S. D. MISRA.

K. R. NAIR.

M. L. ROONWAL.

Branches of Forest Entomology
and Statistics,
Forest Research Institute,
Dehra Dun,
March 17, 1951.

1. Roonwal, M. L., *Curr. Sci.*, Bangalore, 1936, 5, 24.
2. —, *Bull. ent. Res.*, London, 1945, 35, 391-93.
3. —, *Proc. R. Soc. Ind.*, London, 1947, 134B, 245-72, 3 pls.
4. —, *Rev. Indian Mus.*, Calcutta, 1949, 45, 149-65.
5. — and Nag, M. K., *Ibid.*, 1950, 47, 13-23; also in *Proc. 37th Indian Sci. Congr. (Poona)*, 1950, Pt. 3, Abstracts, p. 249.
6. Dirsh, V. M., *Nature*, London, 1951, 167, 281.

FOOD PLANTS OF THE DESERT LOCUST

HUSAIN AND MATHUR (1946) gave three lists of plants, not eaten at all, eaten with great reluctance and eaten readily by the desert locust, *Schistocerca gregaria* Forsk. The first-mentioned list includes onion (*Allium cepa*) and neem (*Melia azadirachta*) plants and observations of two other workers, Roonwal and Bhatia, respectively, are quoted as indicating that neem leaves are 'absolutely avoided' by the desert locust. This has also been the general belief of entomologists, myself included. In July 1950, however, a swarm of desert locusts settled on some neem and other trees in Kanpur city and the locusts nibbled at the neem leaves, though the entire leaves were not eaten. A similar observation was made earlier in June in a village about 50 miles south of Kanpur city. During February 1951, reports were received of damage by locusts to a number of crops, which included onion, in Almora district. Soon after these reports were personally verified by an officer of the Plant Protection Service, U.P., when onion crops were found to have had their leaves eaten away by the locusts.

It would appear, therefore, that the adults of the desert locust are not averse to feeding

either on the leaves of *neem* or on those of onion, though it is possible that they may not do so with avidity. It is noteworthy, however, that, wherever the *neem* and onion leaves were eaten, there were also various other plants present to serve as food for the locusts.

Section of the Entomologist K. E. LAL.
to Government,
Uttar Pradesh,
Kanpur,
March 29, 1951.

1 Husain, M. Afzal and Mathur, C. B. *Indian J. Ent.*, 1946, 8, (2), 141.

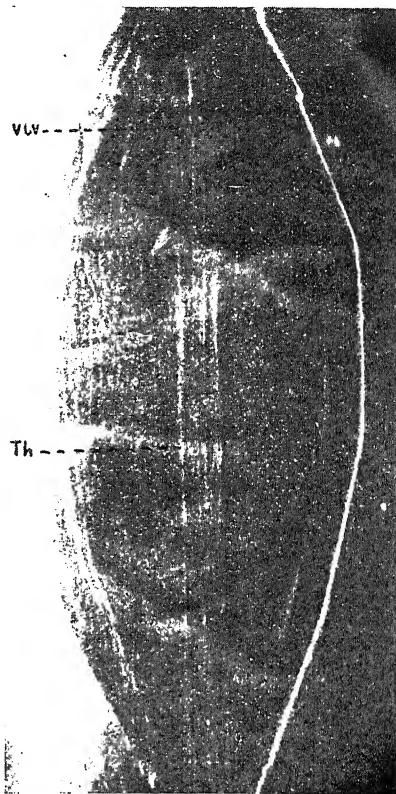
**A NEW ACCESSORY STRUCTURE TO
THE OVIPOSITOR TO AID OVIPOSI-
TION AND BORING IN A PARASITIC
SCELIONID (HYMENOPTERA
PROCTOTRYPOIDEA)**

WHILE studying the morphology of the ovipositor of a Scelionid egg-parasite—*Scelio oviphagæ* sp. nov., parasitic on *Hieroglyphus nigrorepletus* Bol. eggs collected from Ajmer, a peculiar structure, so far undescribed, was noticed in association with the ovipositor, the structure and probable function of which are as follows: The adult female, in certain members of this family, bores through the hard earthen covering of the egg-pods of various Acridiids.

In continuation of the inner valve of the ovipositor an ancillary supporting double-walled structure (Fig. 1) was traceable right up to the 1st (morphologically III) segment of the abdomen. This composite tube in a slide-mounting is indistinguishably continuous with the inner plate of the ovipositor beyond the 7th abdominal segment anteriorly. In the 2nd (morphologically IV) segment, somewhat anteriorly, a pair of thin valvular structures was traced along this tube while near about the IV segment (morphologically VI), the tube appeared to be slightly wider and pouted with crenulations (*th.*) or fine denticles on each side.

As to the function of this organ, it is likely that this is a special structure acting either like a pneumatic drill or at least as a strengthening or supporting structure to the ovipositor as a whole. The paired valves (*vlv.*) of the inner tube allowing, in case of high pressure, the excess air or coelomic fluid to pass through the thin channel to the small anteriormost chamber in continuation with the tube. The crenulations on the tube near about the middle (anterior

edge of the 4th segment) as also the slight widening respectively prevents friction, strengthens and provides flexibility to the long tube during the process of boring.



No segmentation is, however, visible on the tube and it appears to be a continuous one. Ontogenetically, the tube might have been formed by the segmental processes of the abdominal sternites which have got detached entirely from the original sternites during the post-embryonic developments thus forming a tubular structure. As to their chitinous origin there appears to be no doubt, since the entire abdomen was well macerated in cold caustic for about three days.

Division of Entomology, S. MUKERJI,
Indian Agricultural Research Institute,
New Delhi,
May 2, 1951.

REVIEWS

Molecular Spectra and Molecular Structure—
I. Spectra of Diatomic Molecules. By
G. Herzberg. Second Edition. (Van Nos-
trand), 1950. Pp. xv + 658. Price \$9.75.

The first edition of this book has been out of print for some time and the arrival of the new edition will be welcomed by students and workers on molecular spectra. Although the book has been completely revised and brought up to date, its general plan has remained substantially unchanged. It starts with a brief résumé of atomic structure and the observed facts in molecular spectra. Then follow a chapter on the interpretation of the infra-red and Raman spectra based on the rotation and vibration of the molecules and two chapters on electronic states and electric transitions. Applications to other fields of physics, chemistry and astrophysics are contained in the last chapter. Other topics, such as electron configuration, term manifolds, valence, continuous spectra, predissociation, etc., are also discussed in good detail.

While, of course, most of the material is not original, Prof. Herzberg has done a great service by compiling all the diverse information available in a single volume, in which they are presented in a fine analytical manner. Eighty pages at the end of the book are devoted to a table of "Vibrational and Rotational Constants for the Electronic States of all Known Diatomic Molecules", the only table of its kind available at present. A bibliography of 1574 entries gives complete reference to published work on the subject up to 1949. It can be confidently stated that the book will be found indispensable by every worker in molecular spectra.

Scientific Russian: A Text-Book for Classes and Self-Study. By James W. Perry. (Interscience Publishers, Inc., New York), 1950. Price \$7.50.

The book serves a threefold purpose. It is a comprehensive text-book in the classroom, an excellent guide for self-study, and a highly informative work for reference which is furnished with an index (pp. 799-816) giving a complete list of all the grammatical items discussed in the previous lessons. The Russian-English and the English-Russian vocabularies list all the words found in the reading exercises. Hardly

any aspect of Russian syntax and idiom with which the reader of Russian scientific literature must be acquainted, is missing.

From the very beginning, the book under review uses only the vocabulary which is essential for reading scientific texts, leaving aside the phraseology of the everyday language. The book is divided into forty lessons which include reading- and translation-exercises. But more space has been allotted to the reading-exercises which cover two and a half pages in some of the advanced lessons and form coherent discussions of topics such as "The States of Matter", "Atomic Energy", "Sources of Light", "Vitamins", "Radioactivity", "Sodium", "Radar", etc. Throughout the book, the Russian words are printed with their accent, which is a great help for the beginner to pronounce correctly, as some of the Russian vowels have quite different sound values according to whether a syllable is stressed or not.

The author has the gift of discussing all points in a simple and lucid language, avoiding the jargon of the philologist. The get-up of the book is most attractive. The arrangement of the print adds considerably to the clearness of the presentation of the subject-matter. From the aesthetic point of view the book is highly inviting. The book should find a place in the library of all universities and institutes where Russian is taught, and especially where Russian scientific literature is studied.

W. GRAEFE.

Fats and Oils: Soyabean and Soyabean Products, Vol. I. Edited by Klare S. Markley (Interscience Publishers, Inc., New York), 1950. Pp. xvi + 540 and 128 Figs.

This book is in itself an instance of the popularity of soyabeans in America. Almost all the important aspects governing the agricultural production of soyabeans have been dealt with here in a thorough and clear manner. Also, valuable information concerning world production and trade aspects of soyabean is given, together with a detailed account of the chemical and physical composition and chemical characteristics of soyabean oil.

The comprehensive treatment on the proteins and other nitrogenous constituents of soyabean, with particular reference to the isolation of proteins, chemical and physical properties of

soyaproteins and partial and complete hydrolysis of the proteins would be found to be extremely useful by the research workers in this field of study. The chapter on 'Nutritive factors in soyabean products' gives a very clear and complete picture of this very important aspect. Most of the outstanding work carried out on this problem has been well discussed.

Handling and farm storage are also important aspects and these have been dealt with in detail. The biological processes in stored soyabeans are discussed from the standpoint of the conditions of storage as affecting germination and composition of the seed. A complete account of the various methods employed for the mechanical processing of soyabeans is given with sketches of the different machines employed. The reader thus gets a complete story of the soyabean straight from the growing to the final processing stage.

It may not perhaps be out of place to mention here the verdict pronounced by the Soyabean Sub-Committee of the Nutrition Advisory Committee that there was nothing in soyabean to demand any encouragement for the production of soyabean on a large scale. The experimental observations cited in this book on the other hand would indicate that soyabeans are rather outstanding nutritionally, among the legume seeds of the U.S.A.

The book has an excellent get-up and should find a place in every library.

S. S. D.

The Manufacture of Intermediates and Dyes.

An Introduction to Works Practice. By G. H. Frank. (Constable & Co., Ltd., London), 1950. Price 15 sh.

The author has "long and wide experience in the manufacture of intermediates and dyes", and the book is written with the object of showing how these are made and why certain methods and materials are used in practice. The first aim has been partly fulfilled, but not the second. It is true, as the introduction states, that there is need for a modern treatment of the important subject of the manufacture of intermediates and dyes, but this book certainly does not meet it. The technology of dyes, like the technology of other chemical products, has to be based on sound chemistry and sound chemical engineering, and a series of recipes for works processes, assuming their authenticity, do not constitute a suitable text-book for students in colleges and universities. As a guide to knowledge of the latest methods actually employed in the dyestuff industry, a serious defect is the complete omission of the information

on I.G. processes which are now available in numerous BIOS and FIAT reports, microfilms and documents. There is not even a reference to this vast literature.

The choice of intermediates and dyes and their classification are difficult to understand. Part II entitled "Benzene Series" includes sulphur dyes, and Part III, "Naphthalene Series" includes azo dyes; these two classes of dyes are not restricted respectively to benzene and naphthalene intermediates. Diazotization and coupling are dealt with very inadequately, and this is also true of several groups of dyes, such as the anthraquinonoid vat dyes which are disposed off in five pages; azines, oxazines, thiazines (e.g., Methylene Blue), diphenylmethanes, triphenylmethanes, thioindigoids and Indigosols are not even mentioned. Many obsolete names are used, and quite a few formulæ are incorrect. Thus Naphthol AS-G and Naphthol AS-RL are bracketed together, and assigned the structure "Diacetoacetic toluidide of β -hydroxynaphthoic acid". An accurate list of Fast Bases could have been obtained from Saunders' "Aromatic Diazo-Compounds", to which incidentally no reference is made.

The second and third chapters dealing with materials used in the construction of plant and with hazards of the industry are useful; but on the whole this book is very disappointing and does poor justice to an important subject. The book is well printed and the diagrams, mainly supplied by Simon-Carves, Ltd., are excellent.

K. V.

Distillation (Technique of Organic Chemistry, Vol. IV). By A. and E. Rose, F. E. Williams, A. S. Glasebrook, C. S. Carlson, J. R. Bowman, R. S. Tipson, J. E. Hecker and E. S. Perry. (Interscience Publishers, Ltd., London), 1951. Pp. xxvii + 668. Price \$ 14.00.

This treatise on distillation is a welcome addition to the library of the chemist, physicist and the chemical engineer. Since the classical publications of Lewis, Young, Hausbrand, McCabe and Thiele, many investigators have added to our knowledge of the theory and technique of distillation and these recent contributions scattered in journals like *Ind. Eng. Chem.* and *Trans. Am. Inst. Chem. Engrs.* are brought together and presented in easy sequence in this volume.

The theory of batch distillation is discussed excellently by A. and E. Rose in Chapter I, dealing with vapour-liquid compositions, which contains a mathematical treatment of theoretical plates, performance in columns, effects of process variables and is illustrated with curves,

tables and references. Distillation of liquefied gases and low boiling hydrocarbons is described by the same authors in another chapter. Laboratory fractional distillation, apparatus and procedure employed are described in Chapter II. Extractive and azeotropic distillation to separate close-boiling components, entrainer—use, apparatus and industrial applications are treated by C. S. Carlson. Chapter V deals with distillation under moderate vacuum. The chapter by E. S. Perry and J. C. Hecker, discusses the technique employed in high vacuum distillation, such as 'cold finger stills', boiling point still, centrifugal, pot and falling film molecular stills. The vacuum system, free molecular flow, ejector and diffusion pumps, gases, cold traps and leak detectors are discussed in the second half of the chapter. In the last Chapter VII, sublimation or direct crystallisation from the gas phase, as being more efficient than distillation, is classified as vacuum, ordinary and entrainer sublimation. Vertical and horizontal sublimators, as well as fractional microsublimation, useful in analysis of drugs and in pharmacognosy are also discussed in this chapter.

The volume is amply illustrated and provides an up-to-date, comprehensive information to the student and research worker in the laboratory. For the next edition, it may be suggested to include an additional illustrative chapter on industrial distillation, equipment and technique employed in works practice, which would enhance the usefulness of this excellent publication.

Y. K. RAGHUNATHA RAO.

Plant Biochemistry. By James Bonner. (Academic Press, Inc., New York), 1950. Pp. xvii + 537. Price \$ 6.80.

A significant outcome of recent advances achieved in several branches of biochemistry is knowledge concerning the biochemical kinship of all living things. The metabolic processes in micro-organisms, plants, animals and man are all discernably related. This ubiquitous nature of the biochemistry of the living cell has given a new orientation to researches in plant metabolism. Bonner's book admirably sums up existing knowledge on various aspects of the subject. The metabolic pathways in plants that have been discussed here remind one of the important fact how numerous problems of plant biochemistry, hitherto fragmentarily understood, have been and could yet be approached by close application of the information and the

techniques that have been developed by those working with other organisms. The treatise however is concerned not only with the intermediary metabolic processes which are well understood in other groups of organisms, but also with matters which peculiarly concern plants such as the metabolism of starch and of the cell wall, the formation of certain typical secondary products and the biochemistry of photosynthesis.

The book is divided into six sections. Part I deals with carbohydrates, their nature and their simple transformations into sugars and such complex but metabolically active forms as starch and other reserve polysaccharides. Part II is devoted to the cell wall which is largely made up of polysaccharides derived more or less directly from the simple sugars and to a demonstration that cell wall formation constitutes perhaps the largest single drain on the carbohydrate supply of the plant. Part III is concerned with the plant acids and with a lucid exposition of plant respiration as a whole. In Part IV is presented available information on the manner in which proteins and other nitrogenous constituents of the protoplasm are synthesised and otherwise metabolised. The general group of secondary products—lipids, isoprenoids, simple and polyterpenes and the anthocyanins and related compounds—are considered in Part V. The last section (Part VI) gives an outline of the biochemistry of hormonal growth regulation and of presently known facts concerning photosynthesis.

The discussions and interpretations of data are throughout authoritative and reflect the wide experience which Dr. Bonner has had in the field. Although the presentation is linear in sequence, it is also suggestive of the cyclical pattern of metabolic pathways. Thus, beginning with carbohydrates, the book passes on to respiration, proteins, various secondary products and finally, through photosynthesis, to carbohydrates again. One would have looked for some account of ion absorption and mineral nutrition of plants in a book of this kind as these have important biochemical implications.

There are sections for general reading at the end of each chapter together with carefully chosen specific references for the advanced worker. The indexing is good and there are few typographical errors. This monograph is at once both a text-book for the graduate student and a book of reference to the research worker.

A. SREENIVASAN,

SCIENCE NOTES AND NEWS

Raptakos Medical Research Fellowships

The Raptakos Medical Research Board will consider applications for the award of Fellowships for research work in recognized institutions on Medical and allied subjects. The awards normally consist of Rs. 3,000 per year for a Fellowship and Rs. 750 per year towards special equipment or chemicals.

The applications should be accompanied by six copies of a brief statement of the research project and the comments of the guide regarding the suitability of the project and the facilities existing at the Institution. Fellows appointed should have an M.B., B.S., or M.Sc. degree or its equivalent or not less than 2 years' experience in research work after B.Sc. The awards are made annually and may be renewed on the basis of satisfactory progress. Applications for Grants for the year commencing 1st January, 1952, should reach the Secretary, Raptakos Medical Research Board, C/o Raptakos, Brett & Co., Ltd., Dr. Annie Besant Road, Worli, Bombay-18, before 1st September, 1951.

Radioactive Standards

The Joint Commission on Standards, Constants and Units of Radioactivity, in its meeting of July 1950, held at Paris, have agreed to recommend the following definition of the Curie. The Curie is a unit of radioactivity defined as the quantity of any radioactive nuclide in which the number of disintegrations per second is 3.700×10^{10} .

The following abbreviations have also been recommended: c. for curie; mc. for milli-curie; μ c. for micro-curie; Kc. for kilo-curie.

Also, the Commission have agreed that the word 'barn' for 10^{-24} cm.² now in common use as a unit of cross-section for nuclear processes be accepted as the standard unit.

New Ruling Engines for Gratings

Dr. Strong of the Office of Naval Research, U.S.A., has developed a new design of an engine for ruling gratings, in which the grating blank is made to reciprocate beneath a diamond which is supported and moved slowly by two parallel screws, unlike the usual Rowland type. "Fanned" lines are not produced by the new engine, which is designed

for immunity to temperature, friction and wear. The present pilot model machine can rule 14,000 line gratings in sizes up to six inches in about 67 hours.

—(Sky and Telescope, 1951, 10, p. 161)

Heart Surgery

At birth, the heart of a "blue baby" is not properly developed and the blood does not circulate fully through the lungs. The supply of oxygen is therefore restricted and the blood, instead of being a normal red, is overcharged with carbon and has a definite bluish tinge.

In 1945 Drs. Alfred Blalock and Helen B. Taussig, of the Johns Hopkins Hospital, Baltimore, U.S.A., developed a new surgical technique for dealing with the "blue baby", which is to-day in increasing use throughout the world.

W.H.O. is helping to extend the use of these modern methods by sending groups of specialists to demonstrate their technique to the practitioners of countries previously unable to put these advances to practice.

Medicinal Plants in India

A publication which is likely to be of considerable interest to the drug industry in India has been brought out by the Council of Scientific and Industrial Research. Entitled, *Distribution of British Pharmacopœial Drug Plants and Their Substitutes Growing in India*, the bulletin is a comprehensive compendium of the medicinal plants grown in the country together with the regions where they are found naturally. Priced at Rs. 1-4-0 per copy, it is available from the Publications Division of the Council at 20, Pusa Road, New Delhi.

ERRATUM

Vol. 20, No. 5, May 1951, page 131, in the paper, "Effect of Certain Hormones on Growth and Reproduction of some species of *Phytophthora*", read the following description of Plate I:

FIG. showing the inhibitory influence of 1-naphthylarctic acid on the growth of *Phytophthora arecae*.
Ie—Basal medium + Yeast extract, Iev₁—Basal medium + Yeast extract + 1/10 000 conc. of the hormone, and Ic—Basal medium only.

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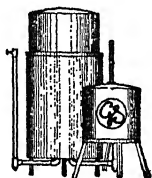
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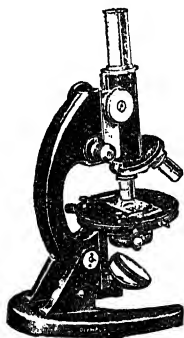


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FISH CULTURE IN RICE FIELDS*

MESSRS. HOFSTEDE AND ARDIWINATA have done a great service to the countries harassed by food shortage and depending upon rice cultivation for their sustenance, by their compilation of statistical data on fish culture in irrigated rice fields in West Java. They have not only assessed the possibilities of various methods, but have also given convincing data of the practicability of these methods. They rightly observe: "Very often the possibilities provided by the irrigated rice fields for the production of fish are still greatly underestimated, in which connection also the interests relating to the local economy and the food production are entirely overlooked."

There are vast areas in the deltaic regions of India where there must be immense possibilities of producing more fish in rice fields and at the same time increasing the yield of much needed paddy crop. In this practice, two factors are of primary importance: (i) the supply of water for the paddy fields, and (ii) the effect of fish culture on rice cultivation, which is, of course, the primary purpose of these fields.

Fish production in rice fields has been classified as follows:

1. *Catch on Irrigated Rice Fields*.—This represents a wild crop estimated at 3 kg. per hectare in a six months period. Even at this low production figure, 2 million hectares of rice fields in Java would yield 6,000 tons of fish per annum.

2. *Fish Rearing as a Secondary Crop*.—This method signifies an alternate raising of two different crops on the same piece of land, and thus corresponds to the paddy and prawn culture practice in Cochin and Travancore. "In actual practice the theoretical production figure per hectare per annum, may be put at roughly 300 kg." of fish.

3. *Fish Culture between Harvest and Planting*.—In West Java, there is arrangement for perennial irrigation, hence the fields can be used continuously. Usually, three harvests are taken every two years. The interval between harvesting and planting is partly used for drying up the fields and partly for short-term fish culture.

4. *Mixed Rice Cultivation and Fish Culture*.—In this system, fish is reared as a "catch crop" during a longer or shorter period on the paddy field whilst the rice is actually growing. According to the "fish growing system" in West Java, a farmer may use his rice field as a nursery or a rearing pond. For example, fry of 1-3 cm. are introduced in a rice field for 20-40 days and fingerlings are harvested.

* Hofstede, A. E. and Ardiwinata. R. O., "Compiling Statistical Data on Fish Culture in Irrigated Rice Fields in West Java," *Landbouw*, 1950, 12, p. 469-94.

Some farmers stock fingerlings of 3-5 cm., 5-8 cm. or 8-12 cm. for periods of 20-40 days, and either sell them as fingerlings of the larger size or raise them to consumption size of 12-20 cm., each weighing 50-75 grammes.

To give practical demonstration of the utility of fish culture in paddy fields, the Extension Service of Indonesia entered into an arrangement with the farmer, "by which the Service was to prepare a number of the paddy plots worked or owned by him, for fish culture, either in combination with his rice cultivation or merely as such. The costs of the materials used and laying out of the plots, and also the costs of any possible decrease in his rice crop, were to be for account of the Fishery Service. The fish so produced was to be given to the farmer". This is by far the best method of demonstration, and the writer as Director of Fisheries, Bengal, had also advocated such an approach.

From experiments thus conducted, data on the following items were collected: (i) cultivation schedule; (ii) paddy varieties; (iii) growth of fish and percentage of losses sustained; (iv) species, individual weights and number of fish stocked; (v) fish production; (vi) length of rearing period; (vii) cultivation methods; (viii) assessment of production, both on fish plots and on the surrounding plain plots, by means of test cuts on marked squares, measuring 10×10 sq. m.; (ix) planting distance of the paddy and (x) elevation, class of paddy field, system of irrigation, etc.

Messrs. Hofstede and Ardiwinata then give an account of the results obtained both from piscatorial and agricultural observations, and record a series of experimental data in detail. From the analysis, they conclude:

1. In the period between the second weeding and the flowering of the paddy, it is quite practicable to have a fish culture lasting 40 to 60 days and to produce within this period 30-50 kg. of fish per hectare. "As a general average one may assume in this form of pisciculture a theoretical annual yield per hectare of 300 kg."

2. The dark carp showed more favourable results than gold carp in this method of fish culture.

3. "In all demonstrations discussed, it is evident that the yield of rice (expressed in the weight of the wet paddy immediately after harvesting) is not inconsiderably increased through the application of this form of fish culture." The average increase noted is 6.3 per cent., and it is attributed to (i) increased tillering action, (ii) control of the growth of weed, (iii) manural value of fish excreta and (iv) the

extra care the farmer takes for the double crop.

In a postscript, the authors draw attention to the importance of the character of the soil and give hints for the use of the Extensive Service personnel. They recognise the paucity of their data for statistical purposes, and strongly advocate that "the combined method of growing paddy and rearing fish should certainly be studied more closely within the compass of measures of this improved growing method".

"Finally it will be necessary to test the statement made by farmers that this form of fish culture has a limiting effect upon rats. It is well known that rats multiply in masses about the time of the flowering of the paddy. The rats inhabit deep holes in the bunds also in those bordering the paddy fields whereas on the one hand the heightened and strengthened bunds required for the combined rice growing and fish culture, provide the rats with a better opportunity to dig runways and nests, on the other hand the higher water level will prevent them from digging such holes and will inundate those they already have made."

At the meeting of the United Nations Scientific Conference for the Conservation and Utilization of Resources in 1949, Dr. E. de Vries and Dr. C. J. Bottemanne also gave an account of fish cultural methods practised in the rice fields of Indonesia, and characterised them as "the most intensive type of cultivation". At the same Conference, Mr. Yoshio Hiyama contributed a paper on "Rice-Paddy Carp Culture in Japan", in which he indicated the lines along which further research should be carried out for increasing the productivity of fish in rice fields. According to Hiyama, "this is one of the best methods of utilizing the natural fish productivity of well fertilized, warm fresh water areas with abundant natural food. It is also a way of supplying animal protein for the farmer" (italics ours). Lin, at this Conference, referred to this practice in China and Hofstede in Indonesia, and stated that the benefit to paddy crop may be as much as 10 per cent increased yield or even more. In a letter dated the 26th January 1944 to the writer, Dr. C. L. Pan, Chief Delegate, Chinese Agricultural Mission to India, stated:

"I would, however, like to bring it to your notice that in China, which is a big rice producing country, there are many indigenous devices and new developments in cultural operations to improve the paddy crop. The most ingenious of all perhaps is the Fish Breeding in Paddy Fields. This controls one of the most serious Insect Pest trouble of our Paddy Crop,

namely, the Stem Borer. The yields have thus been noticed to have increased by about 10-15 per cent. Furthermore, there are clear indication of fish eating up Mosquito Larvæ, thus check their Breeding and Spread of Malaria." (italics ours).

An experiment on Paddy-cum-Fish Culture was started in Bengal in 1945 and in order to facilitate reference in future, its results may be given at this place.

The scheme was set in operation in May 1945 and the data for the district of 24-Parganas are given below*:

Area of paddy fields brought under the scheme	.. 691.16 acres
Carp fry stocked in the above area	.. 4 07 100
Size of fry stocked	.. $\frac{3}{4}$ "-2 $\frac{1}{2}$ "
Cost of fry	.. Rs. 4,502-10-0
Cost of transport of fry	.. Rs. 1,124-8-0
Total number of fish harvested	.. 2,24,158
Range of size of fish recovered	.. 5"-12"
Total weight of fish recovered	.. Mds. 785-34-10
Value at Rs. 40 per maund	.. Rs. 31,463-6-0

Of the fry stocked, 56,850 had been planted in tanks adjoining the paddy fields, and it is remarkable to note that the growth of tank fishes was slower than those liberated in the paddy fields. Some fish had grown to 16" in rice fields while the largest fish recovered from the tanks was only 11". It was estimated that, taking into consideration the full annual production of the fish stocked into the ponds, the total production figure from the scheme may have gone upto 3,000 maunds of fish at the end of one year.

In the district of 24-Parganas, the scheme was taken up for the second year towards the end of April 1946 with a grant of Rs. 9,140. Upto the end of May, the staff went round selecting suitable places and explaining the objects of the development scheme. The scheme envisaged the free distribution of carp fry to farmers who undertook to strengthen the bunds for fish culture in paddy fields. During the next quarter, nurseries for fish larvæ were set up and paddy fields for conducting experiments were inspected. Fry were distributed in September-October to three working units as under:—

1. *Gosaba Units*.—38 paddy fields were approved and 2,31,700 fry of 1 to 2 inches in length were liberated into them. Total expenditure was Rs. 2,521-13-0.

2. *Port Canning Unit*.—36 paddy fields were approved and 2,07,000 fry of 1 to 2 inches in length were stocked into them. Total expenditure was Rs. 1,684-11-0.

3. *Sreekrishnapore Unit*.—24 paddy fields were stocked with 1,45,000 fry of 1-2 inches in length. Total expenditure was Rs. 1,086-2-0.

Up to the end of November, the total expenditure incurred was Rs. 5,285-13-3, for stocking 98 paddy fields with 5,83,700 fry.

By a random sampling at 8 villages, it was found that Catla (*Catla catla*) had grown to 5"-8.3", Rohu (*Labeo rohita*) to 3 $\frac{1}{2}$ "-7" and Mrigal (*Cirrhina mrigala*) to 3"-5 $\frac{1}{2}$ " by the 15th November. It was observed that the fish showed a more rapid growth in paddy fields than in ponds. The following data of growth were obtained from the Gosaba Model Farm. The fish were stocked on the 1st September and harvested on 15th November 1946.

	Size of fry	Average growth in tank	Average growth in paddy field
Catla	1.7"	6.0"	7.8" (9.0" largest)
Rohu	1.5"	5.0"	6.2" (7.3" largest)
Mrigal	1.4"	5.2" (old tank)	6.2" (7.0" largest)

The survival rate was 34 per cent. Catla; 37 per cent. Rohu and 39 per cent. Mrigal. This shows that bottom living Mrigal was somewhat safe from predatory birds even in these shallow waters. Mrigal was also found to be useful for the tillering of paddy but the best results for increased production of paddy were obtained when all the three species were stocked together.

About 972.6 maunds of fish had been recovered by 6th September 1947, besides a large number of young fish that had been stocked in tanks and channels of the Abad areas. Only taking the quantity of fish that was recovered at Rs. 40 per maund, fish worth Rs. 38,905 was produced at a total cost to the Government of Rs. 5,292-10-0. Though no share of it went to Government, the farmers of the area had so much protein food at such a small cost to the public revenue.

The Rice Committee of the FAO, in its meeting at Baguio, Philippines, in 1948 strongly advocated the practice of fish culture in rice fields for the increased production of rice. Now that Messrs. Hofstede and Ardiwinata have given details about various methods of fish culture in irrigated rice fields and have demonstrated statistically the benefit to the rice crop, it may be hoped that India will also take up this programme of food production in a more systematic way, and on a more comprehensive scale.

S. L. HORA.

* One Maund is approximately equal to 82 lb. One Rupee is equal to approximately 1 sh. 6 d.

PHYSICS AND AESTHETICS OF HINDUSTHANI MUSIC*

THE glory of Indian melodic art-music, both Hindusthani and Karnatic, lies in *Gamakas* (movements or graces), which form really their aesthetic feature. The nature of the graces and their physical counterpart in the matter of the slight rise and fall in pitch of notes which it engenders, are the real matters for scientific research in the melodic music of India. Conclusions on theoretical bases are not of much value, and the living art music should be studied by accurate and objective methods known to modern physics, to ascertain the scientific laws behind the art. The studies should be undertaken in collaboration with a physicist of sound knowledge and photographic curves should be obtained by suitable means of *Gamakas*, played true on a violin or vina, to the satisfaction of competent judges.

Considered from this point of view, the recent publication of Mr. Ranade appears rather disappointing. The author perhaps intends the book more for the benefit of the Western reader since no mention has been made in the text of the names of the six Hindusthani *Thats* (seven note ragas) (or the six model scales at page 97) nor of the names of the *svaras* (notes) entering into their composition in Hindusthani nomenclature, except to a small extent in the appendix. His references to flats, double flats, sharps and double sharps of D, E, F, A and B and the European signs affixed thereto (pp. 96 and 97) leave the reader bewildered as they are not used with their accepted meaning¹ though the vibrational values against basic 240 c.p.s., for C, are given.

Following Helmholtz's method of evaluation against the basic 1 of C (*Shadja*) the relative frequencies of the seven notes in the above 6 Ragas, arrived at by the author on theoretical considerations of consonance with the drone—a necessary accompaniment in Indian melodic art-music—are noted below:

1	<i>Bilawal</i>	1	9/8	5/4	4/3	3/2	27/16	15/8	2
2	<i>Khamai</i>	1	9/8	5/4	4/3	3/2	5/3	16/9	2
3	<i>Kafi</i>	1	9/8	6/5	4/3	3/2	27/16	9/5	2
4	<i>Asaveri</i>	1	9/8	6/5	4/3	3/2	8/5	16/9	2
5	<i>Bhairavi</i>	1	16/15	5/4	4/3	3/2	8/5	15/8	2
6	<i>Bhairavi</i>	1	16/15	6/5	4/3	3/2	8/5	9/5	2

The omission as a model scale, of Yaman or Kalyani, one of the seven ancient Grecian scales, is surprising, since that Raga is sung largely both in the North and the South of India.

Items 1, 3, 5 and 6 have the two tetrachords in the relation of the fifth, while those of Items 2 and 4 have the relation of the fourth. The diatonic or major scale of European music, based on the sound principle of major chords from C (*Shadja*), F (*Suddha Madhyama*) and G (*Panchama*) has R.F.'s of 1, 9/8, 5/4, 4/3 3/2, 5/3, 15/8 and 2: and the author's 'Bilawal' scale is the same except that he substitutes for R.F. 5/3, R.F. 27/16. If R.F. 10/9 is substituted for R.F. 9/8, in the diatonic scale the principle of the relation of the fifth in the two tetrachords is satisfied and the result is that all the notes are musical notes including R.F. 10/9 adjudged to be so both by Helmholtz² and the Karnatic musician. In fact these are the frequency values at which the frets have been placed on the South Indian vina (with fixed frets) under the *Shadja* and *Panchama* strings.

Why should not the 'Kafi' scale have R.F.'s 1, 10/9, 32/27, 4/3, 3/2, 5/3, 16/9 and 2, also satisfying the enunciated principle of the fifth in the two tetrachords? The author seems to have entirely ignored the possible existence in the first four scales of R.F. 10/9 in the region of D which is found in the early Grecian scales and in the Arabic scales.³

The above observations have been made to apprise the reader that the notes of scales are only the skeleton frame-work round which we have to clothe the melody and that the *raga* concept is entirely different from the *scale* concept. It does not really matter whether the notes in the scale are a comma sharper or flatter in the matter of the description of the scales. Hence it is that Venkatamakhi fixed his 72 possible scales in relation to the 12 fixed frets of the vina in the octave as $4C_2 \times 4C_3 \times 2$.

The author's statements at p. 132 that (1) the major sixth (R.F. 5/3) has an imperfect dissonance with the tonic in item 4 and (2) the minor sixth (R.F. 8/5) has a perfect dissonance with the tonic in item 5, are certainly incorrect. There is perfect consonance with the tonic in both cases.⁴

The author is rather hard on Karnatic music. A misstatement of fact has, however, to be pointed out. There are not merely 19 parent scales in which Karnatic melodies exist to-day. The great Thiagaraja (1767-1847 A.D.) has created melodic compositions in 45 parent scales (of the 72) and in 220 derivative ragas including those in the less known parent scales even now known and sung by the erudite.

In spite of these criticisms on the purely scientific side, the book will certainly be found

* Hindusthani Music: An outline of its Physics and Aesthetics by G. H. Ranade (Published by the Author, Poona). 2nd Edition, 1951, Pp. 204 + 8. Price Rs. 5.

to be of general interest. It contains a good account of the evolution of Indian Music from the Vedic times and also a bibliography of books for further study.

C. S. AYYAR.

1. Sir James Jeans, *Science and Music*, 1937, p. 166; Helmholtz, *Sensations of Tone*, Ellis' Translation, 1930, p. 17. 2. Helmholtz, *Ibid.*, p. 17. 3. *Ibid.*, pp. 284, 515, 516. 4. *Ibid.*, pp. 14, 332, (Items 29 and 28) and 333, note under table of roughness.

USE OF NITRIC ACID IN THE PRODUCTION OF PHOSPHATE FERTILIZERS

IN view of the difficulties that might arise in maintaining adequate supplies of sulphuric acid to the fertilizer industry, the Chemical Research Laboratory, Teddington, has been studying for the past two years the possibility of making phosphate fertilizers by methods which might effect a saving in the amount of sulphuric acid used. The most obvious alternative to sulphuric acid is nitric acid, for its production does not call for the use of imported raw materials, while the nitrogen value of the acid is recoverable in the form of a nitrogenous fertilizer, and this offsets to some extent the greater cost of the acid as compared

with sulphuric acid. Unfortunately, the action of nitric acid on phosphate rock leads to the production of fertilizer containing much calcium nitrate, which is a highly hygroscopic substance and causes the fertilizer to become damp and difficult to use. Consequently, the work at the Chemical Research Laboratory has largely been confined to the use of mixtures of nitric and sulphuric acids. Actually it has been found that products made in this way are more stable to atmospheric conditions than when nitric acid is used alone. The maximum amount of nitric acid which can be tolerated in order to give a product having a low absorption of moisture is when the mixture of acids contains about 2 mol. of nitric acid to one of sulphuric.

* Courtesy of *Nature*, May 19, 1951.

RESEARCH FELLOWSHIP AWARDS

AT a recent meeting of the Council of the National Institute of Sciences of India, the following awards of Research Fellowships, which are normally for two years, were made:—

NIS Senior Research Fellowships: Dr. A. M. Naqvi, Ph.D., "Solar Problems" at the University of Delhi; Dr. S. C. Shome, Ph.D. (Dacca & Cantab.), "Corrosion of Metals" at the National Metallurgical Laboratory, Jamshedpur; Dr. B. G. L. Swamy, D.Sc. (Mysore), "The Comparative Morphology and Relationships of Some of the Families of the Order Ranales," at the Madras University.

NIS Junior Research Fellowships: Mr. D. Basu, M.A., "The Waldian Approach to the Problems of Estimation," at the Indian Statistical Institute, Calcutta; Dr. M. Datta, D.Phil., "New Probabilistic Approach to the Basis of Statistical Physics," at the Calcutta University; Dr. A. M. Mehta, D.Phil. (Oxon.), "Investigation of Biles (from Slaughter-Houses in Bombay) with a View to Search for 11 and 12 Oxygenated Steroids Needed for Synthesis of Anti-Arthritic Compounds Related to Cortisone," at the Haff-

kine Institute, Bombay; Dr. A. K. Mukherjee, M.B., D.T.M., "Cultivation of *E. histolytica* in a Bacteria free Medium," at the Indian Institute for Medical Research, Calcutta; Dr. (Mrs.) T. S. Sarojini, Ph.D. (Madras), "Studies in Soil Fungi with Special Reference to Fusarioid Disease of *Cajanus*," at the Madras University; Mr. E. G. Silas, B.Sc. (Hon. Madras), "the Zoogeography of the Western Ghats as Evidenced by Distribution of Fishes," at the Madras University; Mr. T. B. Sinha, M.Sc. (Alld.), "the Morphology and taxonomy of Mites," at the Allahabad University.

ICI (India) Research Fellowships: Dr. B. K. Banerjee, D.Phil. (Cal.), "Physico-chemical Studies of Glass," at the Indian Association for the Cultivation of Science, Calcutta; Dr. A. Ganguli, Ph.D. (Edin.), "Investigation on Potato Virus Diseases," at the Bose Institute, Calcutta; Dr. P. T. Rao, D.Sc. (Waltair), "Complex Molecular Spectra of the Transition Groups of Elements (in the Near-Infrared and the Visible)," at the Andhra University, Waltair.

LETTERS TO THE EDITOR

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ELECTRONIC BANDS OF
PARADIBROMOBENZENE

PARADIBROMOBENZENE belongs to the symmetry class V_h like the corresponding molecule *paradichlorobenzene*. According to ideas developed by Sponer in interpreting the structure of benzene and of substituted benzenes, the near ultra-violet electronic transition $A_{1g} \rightarrow B_{2u}$ of benzene becomes $A_{1g} \rightarrow B_{3u}$ in *paradibromobenzene* with the dipole moment in the molecular plane and perpendicular to the *para* carbons. The transition is an allowed one with the migration moment parallel to x . About 60 bands have been measured in the region $\lambda 2840$ to $\lambda 2570$, in the absorption spectrum of the substance photographed in the vapour state at different temperatures, the

substance being enclosed in a special all-quartz tube. The main features confirmed the theoretical predictions. The 0, 0 band is located at $\nu 35643$. Four definite frequencies of the upper state 470, 677, 1014 and 1449 cm^{-1} have been identified. Bands are detected corresponding to difference frequencies 21 and 86 cm^{-1} . As in *paradichlorobenzene* the bands occur in a number of different groups. The strongest bands in these groups are found to be associated with a number of close-lying bands on the long wavelength side.

Detailed analysis will be published elsewhere. Physics Dept., K. SREERAMAMURTY, Andhra University, Waltair, October 15, 1950.

MOLECULAR DIFFRACTION UNDER HIGH VACUUM

PARAFFIN was slowly evaporated at a temperature slightly above its melting point through a rectangular aperture ($1'' \times \frac{3}{4}''$) in the apparatus already described by the author.¹ At pressures of the order of 10^{-4} cm. Hg, patterns similar to optical diffraction patterns were obtained (Figs. 1 and 2) with either a central maximum or a central minimum.

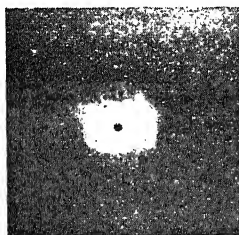


FIG. 1

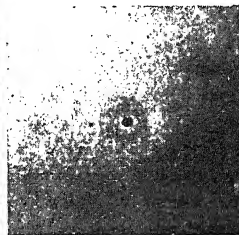


FIG. 2

As in the case of the periodic deposits described earlier¹ the results suggest that the phenomenon is to be ascribed to a wave-like character of the streaming particles. By using the formulæ, $\lambda = aw/d$, where a is the length of a side of the rectangular aperture, w is half the width of the central maximum or minimum in the deposit and d is the distance between the collecting plate and the aperture, the wavelength is calculated to be 1.4 mm. and the corresponding wave-number is 7.3 cm.^{-1} which is probably due to the rotational oscillation of a part of the molecule about the other part.

The experiment has been repeated using brass and glass plates as collecting plates and the results were reproducible showing that surface action cannot be the origin of the phenomenon.

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March 30, 1951.

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EXPERIMENTAL EVIDENCE FOR THE EXISTENCE OF TRANSVERSE THERMAL WAVES IN LIQUIDS

A CALCULATION¹ of the hypersonic velocity in glycerine from the Doppler-shift of frequency of monochromatic light in Brillouin scattering due to coherent fluctuations of density, gave a value of 2,500 metres per second at 26°C. as against a value of 1967 m/sec. at 28.5°C. for an ultrasonic frequency of about 10^7 sec.^{-1} . This observed increase of velocity in the hypersonic region has

been adduced as evidence showing that glycerine behaves like a rigid solid for such frequencies. From the rigidity modulus derived from the two velocities, the time of relaxation has been calculated and found to have a value of $4.2 \times 10^{-10} \text{ sec.}$, which is greater than the vibration-period of the hypersonic wave, namely $0.64 \times 10^{-10} \text{ sec.}$ In the same circumstance, one should expect the existence of transverse waves also in the liquid; but a search for the transverse components in Brillouin scattering was unsuccessful.

On the basis of the 'hole theory' of liquids, Frenkel² has shown that the rotational vibrations of anisotropic molecules about their centre of gravity in a liquid body should give rise to three types of scattering, namely (1) a purely angular part, (2) a translational-angular part of the longitudinal type, referred to as l_a and (3) a translational-angular part of the transverse type, referred to as t_a . These three constitute depolarised "anisotropic scattering". The l_a and t_a types of motions of molecules should give rise to Doppler-shifted components and unmodified components in light-scattering, in the same way as the purely translational motions.

Interferometric studies³ of monochromatic light from a zinc arc scattered by several liquids have shown that, besides the well-defined Brillouin components due to 'density waves' and a depolarised background due to purely 'rotational scattering', there exists a continuous band between the central component and the two Brillouin components on either side. The intensity of this continuous band depends on the optical anisotropy of the molecule. It is best observed in liquids like ethyl alcohol and acetone whose depolarisation ratio, ρ , lies between 0.15 and 0.30; for higher values of ρ , it tends to be masked by the rotational scattering. The origin of this continuous band was not clear at the time of publication of the results. Applying Frenkel's theory, it becomes clear that this continuum arises from a Brillouin scattering by the transverse (t_a) waves in the liquid, broadened out by damping, and provides experimental evidence for the existence of transverse thermal waves in liquids.

A weak unmodified depolarised component is to be expected due to "entropy fluctuations" of these transverse (or t_a^s) waves. In fact my studies⁴ have shown that the central component in Brillouin scattering is not perfectly polarised, as it should be if it were due to the density scattering only. This observation of a feeble depolarisation of the unmodified component has been confirmed by later workers.⁵ This

lends additional evidence to the view that transverse thermal waves are present in liquids.

University College, C. S. VENKATESWARAN.
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PRODUCTION OF JOSHI EFFECT IN IODINE VAPOUR UNDER X-RAYS

A NEGATIVE Joshi-effect ($+\Delta i$) was observed by Joshi¹ in chlorine on irradiation by X-rays. Recently Saxena and Karmalkar² have reported for iodine vapour $-\Delta i$ with visible light but only a positive Joshi-effect $+\Delta i$ under X-rays. Studies in these Laboratories^{3,4} under a wide range of operative conditions of a number of excited media have, however, shown the production of both $\pm\Delta i$. Table I is a typical set of data, observed with excited iodine vapour, employing an experimental technique similar to that of Joshi.

TABLE I
Exciting potential = 4.5 kV (r.m.s.)
Current in dark $i_D = 82.0$ (arbitrary units)

Anode Voltage in kV \ Tube current in mA		0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
10.8	% Δi	- 2.8	- 7.3	-10.0	- 2.9	-1.0	-0.6	-0.0	+1.7	+3.5
13.9	% Δi	- 8.6	-12.0	-14.8	- 8.0	-5.0	- 2.5	-1.8	-0.4	+1.0
17.0	% Δi	-12.8	-17.8	-21.2	-12.5	-8.3	-5.6	-4.8	-2.8	-0.8

The following important results emerge out of this work: (1) whilst $-\Delta i$ is definite enough under X-rays, its range of occurrence and magnitude are determined by (a) applied potential; (b) nature and concentration of the excited material; (c) intensity and hardness of the X-rays; (d) frequency response of the detector circuit. (2) The relative Joshi-effect ($-\% \Delta i$) increases with the increase in the voltage on the X-ray tube. (3) With the increase of the intensity I, $-\Delta i$ rises from an almost negligible value at low I, to a maximum at a tube current of about 2.0 mA; thereafter it decreases and then remarkably enough changes sign at

high I (6 to 9 mA). A like reversal to $\pm\Delta i$, at large I (tube current, 12 mA) is observed in bromine vapour also. The optimum intensity I depends, *inter alia*, on the electron affinity of the excited medium.

Saxena and Karmalkar have not indicated the hardness and especially the intensity of their X-ray beam; it is very likely that their results were made under highly intense X-rays. Their explanation, which attributes the negative Joshi-effect exclusively to the negative ionic space charge would lead to its decrease with the frequency of X-rays, which is contrary to our finding.

The results can, however, be interpreted on Joshi's⁵ theory supported by the analogous character of the ozoniser discharge and the corona. The h.f. pulses in the ozoniser discharge are similar to the Trichel⁶ pulses observed in the corona. Each pulse is characterised by electronic motion during its rapid growth (the 'active time', t_a) and the (positive) ionic motion during its slow decline (the 'clearing time', t_m). Montgomery⁷ have shown that $i = Q/(t_a + t_m)$ in such a type of discharge where Q is the charge collected during a pulse. Electrons emitted during t_a produce Townsend avalanches, leaving behind an additional space

charge (B) between the initial space charge (A) and the cathode. This is similar to a two-sheath problem in a G.M. counter discussed by Wilkinson.⁸ (B) reduces the field near the anode causing a decrease in Q and the pulse height. In addition t_m is increased due to the screening action of (B). Both these cause $-\Delta i$. Electrons emitted from the cathode during t_m enhance the positive ionic space charge increasing t_m . Thus irradiation during t_a and t_m results in $-\Delta i$ and the decrease in the pulse height. On the above mechanism an increase in frequency and intensity of X-rays producing enhanced (B) should result in greater $-\Delta i$.

In certain cases, especially halogens, the electrons in the avalanche are captured by excited atoms to form negative ions. The enhancement of negative ionic space charge results in an increase¹⁰ of V_m and $1/i$ under irradiation.

Dept. of Physics,
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OVERFOLDING OF THE UPPERMOST CUDDAPAH SOUTH OF KAREMPUDI

THE problem of the age of the Palnads is highly controverted on account of the absence of a recognisable unconformity in the southern limits of the Palnad formations. W. King¹ made a brilliant suggestion that there was reduplication of the Kistnah beds in the middle of the Waumyconda range, Guntur District. The present note gives an account of an observed overfold in the Kistnahs south of Karempudi, and this appears to indicate why no unconformity has been recognized in this area. In a pass called 'Nayakurali Alugu' in the Waumyconda range, the overfold is recognised with its axis and the recumbent folding. The fold pivots on the Irlaconda quartzite, which forms the axis of the fold. On either side of this are the Kolumnala slates with an interbanded quartzite. This is succeeded by the Sreeshailum quartzite. The fold is asymmetric; the beds towards the north of the axis being thicker than those to the south, with the beds on either side dipping south-east. At the junction of the Cumbum slates and the uppermost Cuddapah quartzites, slickensides and breccia are noted. The recognition of current bedding in a nearly vertical attitude in the Irlaconda quartzites of the fold definitely proves the uplifting of the beds and of folding.

These observations seem to indicate that subsequent to the deposition of the uppermost Cuddapahs, the beds were subjected to uplift resulting in the formation of an overfold and

subsidence took place from the northern fringe of the Waumyconda range at a later stage followed by the deposition of the Palnads. The Palnad beds are unaffected by tectonic movements that folded the Cuddapahs. It is therefore natural to expect that the Palnads do not overlie the uppermost Cuddapahs but occur flanking the folded formations of the Kistnah beds. The complete succession of the Palnads from the conglomerates to the limestones is however recognised in the Durgi and Manchikallu areas in the Palnad basin. The detailed geology of this area by one of us (G. V. U. R.) is under publication elsewhere.

Geology Dept., C. MAHADEVAN.
Andhra University, G. V. UMAMAHESWARA RAO.
Waltair,
January 27, 1951.

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MODE OF ACTION OF PALUDRINE

WITH reference to glucose utilisation of *P. gallinaceum* in the presence of paludrine, Marshall¹ concluded that paludrine exerted its antimalarial action at least partially by inhibiting the oxidation processes in the parasites but did not directly interfere with the breakdown of glucose. Wright and Sabine² observed that atebriane has definite inhibitory action on tissue respiration and *d*-amino acid oxidase activity and inferred that atebriane may be capable of competition *in vivo* for one or more essential proteins with flavine nucleotides. In this note is described the effect of paludrine on the respiration of malarial parasites, *P. gallinaceum*, and also on *d*-amino acid oxidase.

Method.—Measurements of oxygen consumption were made with a Warburg manometer of the classical type fitted with side-arm flasks of approximately 20 ml. capacity. The suspension medium was a phosphate buffer pH 7.3 of the following composition.

NaCl 0.0068M., KCl 0.0865M., Na_2HPO_4 0.0275M., KH_2PO_4 0.0025M., MgSO_4 0.0015M. Each flask contained a cell suspension of 0.5 ml. diluted to a total vol. 2.5 ml. Glucose was added to a final concentration of 0.0058M.

The parasitised blood was centrifuged and the cell washed twice in buffer salt solution containing the glucose and resuspended to the original blood vol. in the same medium.

D-amino acid oxidase was prepared as described by Krebs.³ Sheep kidneys were ground, washed with acetone and stored in a vacuum desiccator. 0.5 g. of the kidney was ground with

sand and 15 ml. of water, centrifuged and the supernatant was used as the enzyme preparation.

Results.—The effect of paludrine on the respiration of chick's erythrocytes infected with *P. gallinaceum* is shown in Table I. The results of three experiments on the oxygen consumption of normal non-parasitised erythrocytes (1.3×10^6) show that 36 c.mm. of oxygen are consumed during a period of two hours.

Paludrine was tipped from the side-arm of the manometric flask, exactly 25 minutes after placing the flask in the thermostat.

TABLE I

+ Drug concn.	No. of expts.	Oxygen consumption in 2 hrs.	% of inhibition
Nil	4	153 C. mm.	..
1×10^{-5}	4	145 "	5.2
2.5×10^{-5}	4	97 "	36.6
1×10^{-4}	4	52 "	66.0
2.5×10^{-4}	4	15 "	90.2

Substrate Glucose $\cdot 0058$ M; R.B.C. 1.3×10^6 ; Temp. 38°C .; Gasphase Oxygen. % of Parasite 46; pH 7.3° ;

Table II gives the rate of consumption of oxygen during the oxidation of *dl*-alanine by *d*-amino acid oxidase in substrates containing paludrine as well as free from it.

TABLE II

Time in min.	10	20	30	40	50	60
Paludrine concentration	Oxygen consumption in c.mm.					
1 in 5000	..	27	43	61	81	101
1 in 2500	..	26	48	68	89	105
1 in 1500	..	25	45	62	81	99
Nil	..	29	49	71	91	107

Substrate: *dl* alanine (10%) 0.1 ml.

Buffer: M/10 Phosphate pH 7.4

Temp. 35°C . Gasphase Oxygen

The results show that paludrine even at very high concentrations has no appreciable effect on the oxidation of *dl*-alanine by *d*-amino acid oxidase. *d*-amino acid oxidase is a relatively stable representative of flavo-proteins capable of dissociation. Thus the mode of action of paludrine seems to differ from that of atebriane in that atebriane interferes with respiration possibly through the yellow enzymes whereas the inhibition of respiration by paludrine cannot be concluded to be due to the effect on flavo-

proteins, but might be due to interference with some other oxidative enzymes.

Pharmacology Labs., V. R. SRINIVASAN.
Indian Inst. of Science, N. N. DE.
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EFFECT OF REMOVING RESIDUAL MOISTURE FROM OVEN-DRIED SOILS ON THEIR PHYSICO-CHEMICAL REACTIVITY

THE present study relates to the effect of 'activation' treatment on some physico-chemical properties of a few typical soils.

The soils were rendered base-free by prolonged leaching with N/20 HCl followed by washing with water. After drying to a constant weight at 110°C ., a portion of each soil was 'activated' by heating at 200°C . and passing through it a stream of dried air for 6 hours continuously.

The following properties of the soils were determined before and after the 'activation' treatment:—

1. **pH Value:** Soil suspensions in water in the ratio of 1:10, were shaken for 2 hours and the pH values determined using glass electrode.

2. **Titration Curves:** Increasing amounts of 0.1 N. NaOH solution were added to one gram portions of each soil and the volume was made 10 c.c., in each case. The pH values were determined after shaking the suspensions for 48 hours. The neutralisation values, equivalent to the amount of alkali required to raise the initial pH value by 4 pH units,¹ were interpolated from the graphs.

TABLE I

Effect of removing residual moisture on the pH, neutralisation and ammonia absorption values of soils

Soil No.	pH value		Neutralisation value		Ammonia absorption	
	(1)	(2)	(1)	(2)	(1)	(2)
	m.e./100 g. soil		m.e./100 g. soil		m.e./100 g. soil	
6	4.54	4.14	6.3	8.4	4.8	6.4
13	3.10	2.87	44.0	52.2	42.7	54.8
123	5.47	5.02	27.5	32.2	24.5	31.6
172	4.60	4.36	30.7	40.2	30.4	37.2

(1) Before removing residual moisture.

(2) After removing residual moisture.

TABLE II

Effect of removing residual moisture on the moisture absorption-vapour pressure relationships and heat of wetting of soils

Soil No.	Percentage moisture absorbed at different relative humidities							Heat of wetting
	10%	30%	50%	70%	90%	99%		
6	Before removing moisture	1.06	1.42	1.79	2.76	4.91	7.51	2.34
	After ,, ,,	1.56	1.80	2.11	3.25	5.22	9.63	3.93
13	Before ,, ,,	4.10	7.34	8.59	11.07	12.89	16.79	10.90
	After ,, ,,	4.60	7.58	8.93	11.97	13.85	18.33	14.74
123	Before ,, ,,	0.74	3.31	3.35	7.25	10.63	14.82	5.48
	After ,, ,,	1.48	4.41	5.29	8.01	11.22	16.94	6.66
172	Before ,, ,,	2.62	4.36	5.17	6.86	8.34	10.84	7.62
	After ,, ,,	2.86	4.65	6.05	7.80	9.54	12.25	9.90

3. *Ammonia Absorption Values*: 5 gram portions of the soils were kept in contact with excess of N. ammonia solution for 48 hours, then boiling off the excess and determining the amount retained by distilling with alkali.²

4. *Moisture Absorption—Vapour Pressure Relationships*: 5 gram portions of the soils were placed in desiccators containing $H_2SO_4-H_2O$ mixtures corresponding to different relative humidities and the increase in weight determined when equilibrium was attained.

5. *Heat of Wetting*: 5 gram portion of each soil was mixed with 150 c.c. water contained in a thermos flask and the amount of heat developed was calculated from the rise in temperature recorded with a Beckmann thermometer.

Table I shows pH, neutralisation and ammonia absorption values and Table II hygroscopicity and heat of wetting. It is seen that the removal of residual moisture from soils leads to increased reactivity towards alkalies as well as increased hygroscopicity. This appears to be due to the availability of greater pore space which increases the 'active' surface of soils.

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THE ENGINEERING PROPERTIES OF A CLAY SOIL OF WEST BENGAL

The present note records the results (Table I) obtained with a clayey soil of West Bengal (collected from Hoogly and locally known as 'ahtel' soil), using the methods of Brown and Hogentogler.¹

TABLE I

1	Grading (oven-dried basis):	
	(i) clay	.. 50.1%
	(ii) silt	.. 26.9%
	(iii) coarse sand	.. 4.7%
	(iv) fine sand	.. 17.2%
2	Moisture in air-dried sample	.. 6.3%
3	Apparent density	.. 1.6%
4	Moisture content of saturated soil	.. 38.3%
5	Pore space	.. 55.0%
6	Volume expansion	.. 25.4%
7	Field moisture equivalent	.. 27.0%
8	Shrinkage limit	.. 8.0%
9	Shrinkage ratio	.. 1.95
10	Lower liquid limit	.. 45.0%
11	Plastic limit	.. 21.7%
12	Plasticity index	.. 23.3%

A comparison of the data presented in Table I with the range of the numerical values of the physical constants of the different groups¹ of soils suggests that the soil in question belongs to the A-7 group (compare also Chatterjee²). The data also accounts for the observed properties of 'ahtel' soil. These are: plastic at certain moisture content; low internal friction; high expansion and shrinkage properties; can be compacted to high permanent density except at certain moisture content; may have considerable volume change and sometimes cause concrete pavement to crack and fault.

Since 'ahtel' soil belongs to the A-7 group, it is fairly suitable for foundation work and

earth-dam construction¹ and as fill material after stabilisation by densification, but not so for highway and airport construction; it can be used for these purposes *only after* elaborate treatments.

Further work on the stabilisation of this soil is in progress.

The authors' thanks are due to Drs. S. R. Sen Gupta and Walter Baukloh of the Bengal Engineering College for their kind interest.

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THE OXALATE CONTENT OF GINGELLY (*SESAMUM INDICUM*) SEEDS

GINGELLY SEEDS contain much more calcium than the other common oil seeds.¹ The nutritive value of the seeds has actually been attributed to this high calcium content.² The seeds, however, also contain a high proportion of oxalate³ so that at least a part of the calcium would be unavailable physiologically. As it appears to be of interest to determine what proportion of calcium is rendered unavailable due to the presence of oxalate, the results of analysis for their calcium and oxalate contents of some gingelly seeds obtained locally are reported here.

The cleaned and crushed seeds, both white and black variety, were defatted by soxhletting with light petroleum, and dried for about half an hour at 100° C. Oxalate in the finely ground meal was determined according to Otto⁴ and calcium according to Ranganathan, *et al.*¹ Calcium was also determined in the whole seeds. The following table gives the average values obtained:

	Average value for Ca (%)		Average value for oxalate in meal expressed in terms of its equivalent as Ca (%)	% of unavailable calcium
	in whole seed	in meal		
White	1.30	2.68	1.84	61.7
Black	1.38	2.48	1.16	46.8

The simultaneous occurrence of large amounts of calcium and of oxalate makes it highly probable that the main part if not all of the oxalate in the seed is present as its calcium

salt. It may therefore be assumed that nearly half to two-thirds of the calcium in the seed are rendered unavailable.

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CHLORINATION OF ORGANIC COMPOUNDS UNDER SILENT ELECTRICAL DISCHARGE

ARISING out of earlier work¹ a series of results have been observed for the chlorination of organic compounds under electrical discharge, on which but little information can be had from the literature. Thus in its vapour phase, on chlorination in presence of sunlight, toluene yields benzyl (85 per cent.), benzal (6.8 per cent.), benzotri- (2.3 per cent.) chlorides, under a wide range of operative conditions. When, however, subjected to an ozoniser discharge due to A.C. potentials in the range 8 to 12 kV. of 50 cycle frequency, it was striking to observe that the above order is practically reversed. At 9 kV. and 50 cycles, the following yields were obtained in the case of toluene: 45 per cent. benzotri-, 25-30 per cent. benzal and 10-12 per cent. benzyl chlorides and some nuclear substitution products. These results could be obtained in about half the time when the frequency was changed to 500 cycles. Irradiation of the system or/and amplification of the surface volume ratio by introduction in the annular space of powdered wall material, are additional and potent parameters in respect of both the yield and nature of the reaction. Thus, on irradiation of the system (200 watt bulb) the yield of benzyl chloride increased from 12 per cent. to about 35 per cent. at 9 kV. exciting potential and that of $C_6H_5Cl_6$ (*vide infra*) increased with the introduction in the annular space of powdered wall material, from 24 to 38-40 per cent.

In the chlorination of benzene under discharge in dark the chief product is C_6H_5Cl as

against C_6Cl_6 produced thermochemically or the familiar addition compound in presence of bright sunlight. Under electrical discharge, benzene yields olefines including ethylene.^{3,3} It is known⁴ that ethylene reacts with benzene catalytically in the formation of the addition compound under light. That the discharge reaction, even in the absence of special conditions, simulates in part the other types, is shown by the fact that a small but a sensible proportion of the nuclear products (C_6H_7Cl) are formed. Thus about 2 per cent. nuclear products are produced in benzene, and 8-10 per cent. in the case of toluene.

The remarkable isomerism exhibited by $C_6H_6Cl_6$ -hexachlorocyclohexane has been of special structural interest. The γ -isomer (gammexane) is an important insecticide.⁵ The distribution of these isomers in the products obtained by chlorination under discharge, is not without technical interest. Actual results of the author show that at specially higher exciting potential (12-15 kV.) and under irradiation, γ -, and δ -, isomer formation is increased by about 20 per cent.

Grateful thanks are due to Prof. S. S. Joshi, Banaras, for kind help and advice.

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March 21, 1951.

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VITAMIN B_{12} IN INFANTILE CIRRHOISIS

RECENTLY Sunder Rao, *et al.*¹ have published their preliminary observations on the therapeutic effect of vitamin B_{12} in infantile hepatic cirrhosis. During the past nine months, we have also been engaged on a similar study and are recording here our own experiences.

To date, we have treated in all twelve cases including the early as well as the advanced stages of the disease. Of the cases treated three were early cases with soft, enlarged liver and spleen, four had hard liver and firm spleen, and the rest five cases had jaundice, oedema and ascites when B_{12} therapy was instituted.

The vitamin was administered intramuscularly in 30 mcg. doses twice a week. A low fat diet was prescribed. Secondary complications such as temperature, constipation, etc., were treated symptomatically. Two of the

advanced cases without icterus and all the cases with jaundice and ascites were given in addition to B_{12} an oral supplement of 25-30 g. casein hydrolysate a day.

The prognosis has been judged on clinical grounds, the restoration of blood picture and serum protein levels and the response to liver function tests. Although there were no strict control cases, the clinical response in these cases has been compared with that produced by a therapeutic regimen comprising protein hydrolysate, liver extract and vitamins of the B-complex which we have found by clinical trials in over five hundred cases to give beneficial results in the early as well as the fairly advanced cases.²

All the early cases which were prescribed only vitamin B_{12} recovered completely in 4-5 weeks of treatment. Of the advanced cases without icterus or ascites, the two cases which were given the protein hydrolysate supplement in addition to B_{12} have shown better general improvement and more rapid recession and softening of the liver than the other two which received only B_{12} . These cases are still under observation and treatment. In the icteric stage of the disease, the administration of the vitamin brought about improvement in the general condition of the cases in the first instance but ultimately failed to avert the fatal termination. However, in these cases, the depth of jaundice was much less and the period of survival after the onset of frank icterus longer (6-8 weeks) as compared with similar cases previously observed.

The trend of these preliminary results, which are in general similar to those reported by Sunder Rao, *et al.* indicates that while vitamin B_{12} alone may be effective in the early stage of the disease, supplementation with predigested protein produces rapid and satisfactory response in the more advanced condition, and even in the icteric phase tends to arrest the rapid progress of the disease. Further work is in progress.

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April 22, 1951.

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THIOCARBAMIDO DERIVATIVES OF DIARYL SULPHONES AND SULPHIDES

IN a previous communication biguanido derivatives of diaryl sulphones and sulphides have been reported. In this part mono- and bis-thiocarbamido derivatives are described. The thioureas were prepared by refluxing the amine with the corresponding mustard oil in an alcoholic medium and purified by dissolving them in alkali and reprecipitating with acid and subsequent crystallisation from alcohol. Some of these compounds have shown marked antibacterial properties in *in vitro* tests.

The melting points of these compounds are recorded below.

R	$(R-X-C_6H_4)_2SO_2$	$R-X-C_6H_4 \cdot S \cdot C_6H_4NO_2$	$R-X-C_6H_4 \cdot SO_2-C_6H_4NO_2$
1 C_6H_5-	.. 213°	189°	180°
2 $p\text{-Cl-C}_6\text{H}_4-$	.. 198°	..	..
3 $p\text{-Br-C}_6\text{H}_4-$	.. 191°	..	92°
4 $p\text{-I-C}_6\text{H}_4-$	.. 192°	185°	84°
5 $p\text{-CH}_3\text{-C}_6\text{H}_4-$	.. 203°	..	..
6 $o\text{-CH}_3\text{-C}_6\text{H}_4-$	.. 206°	..	..
7 $m\text{-CH}_3\text{-C}_6\text{H}_4-$	.. 210°	..	..
8 $CH_2=CH\text{-CH}_2-$	.. 181°	146°	176°
9 $o\text{-(CH}_3)_2\text{C}_6\text{H}_3-$	.. 211°	..	..
10 $p\text{-(CH}_3)_2\text{C}_6\text{H}_3-$	.. 246°	..	..

X = -NH-CS-NH-

Attempts to make the corresponding SET and SME compounds from the thioureas were not successful. The unsubstituted bis-thiourea derivative of diamino-diphenyl sulphone also could not be prepared by reacting the base with thiocyanic acid.

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June 12, 1951.

GUANIDO DERIVATIVES OF DIARYL SULPHONES AND SULFIDES

IN continuation of the work already reported, guanido derivatives of 4:4'-diaminodiphenyl sulfide and sulfone 4-nitro-4'-amino diphenyl sulfide and sulfone, have been prepared with a view to studying their pharmacological prop-

erties. These compounds were obtained by refluxing the amine hydrochlorides with various arylcyanamides in a suitable medium (alcohol) and purified through crystallization from dilute alcohol or water. The aryl cyanamides required for the condensations were obtained by desulfurization of the thioureas prepared from the corresponding amines. The compounds are under pharmacological investigation.

The melting points of the compounds are tabulated below:

R	$(R-X-C_6H_4)_2S$	$(R-X-C_6H_4)_2SO_2$	$R-X-C_6H_4 \begin{array}{c} \diagup S \diagdown \\ O_2N-C_6H_4 \end{array}$	$R-X-C_6H_4 \begin{array}{c} \diagup SO_2 \diagdown \\ O_2N-C_6H_4 \end{array}$
1 C_6H_5-	.. 154-6°	197-9°	174°	160°
2 $p\text{-Cl-C}_6\text{H}_4-$.. 140-51°	183	163°	150-2°
3 $p\text{-Br-C}_6\text{H}_4-$.. 139°	170	140°	138°
4 $p\text{-CH}_3\text{-C}_6\text{H}_4-$.. 145°	180°	159°	148°

X = -NH-C-NH-
 ||
 NH

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June 12, 1951.

THE DEVELOPMENT OF MOTILITY IN THE SPERMATOZOA OF THE ALBINO RAT AND THE GOLDEN HAMSTER*

SIX sexually mature male albino rats and golden hamsters were obtained and chloroformed. The animals were then pithed by breaking the vertebral column at the junction of the head and the neck. The abdomen was then cut open and the entire reproductive tract removed within a few minutes after the unconsciousness of the animals. The secretions from the different regions of the reproductive tract were examined immediately after collection for motility under the microscope without the addition of any diluent. The secretions were spread in a thin layer before microscopic examination, all examinations being carried out at 100° F.

* This work was completed in August 1948, at the University of Missouri, Columbia, Missouri, U.S.A., when the author was a graduate student in the Department of Animal Husbandry. The encouragement and guidance of Dr. Dennis T. Mayer is very deeply appreciated.

The sperm collected from the testis and the head and body of the epididymis of the rat and the golden hamster showed very poor motility, and only a slight improvement in motility could be noticed on the addition of 0.9 per cent. saline and warming to 100° F. The secretions collected from the tail of the epididymis were thick and viscous but even here with a very high sperm concentration sperm could be seen being gently swept across the microscopic field in waves. The motility is not maximal nor the disturbance in the microscopic field violent in view of the very high sperm concentration and the viscosity of the secretions. It is extremely important that the examination of these preparations should be made quickly since the movement is greatly impeded by the rapid drying of these secretions. The motility of the sperm at once becomes maximal after the addition of a drop of 0.9 per cent. saline or 5 per cent. glucose solution or any other isotonic solution and warming to 100° F. This stimulatory effect on sperm motility appears to be due mainly to the lowering of the viscosity of the secretions as well as to the reduced sperm concentration which renders the lashings of the tails of the sperm more effective and motility more easy. The secretions from the ampulla were less viscous than those from the tail of the epididymis and the sperm motility was very active although not maximal and gentle wave-like movement could be noticed in the microscopic field. The motility becomes maximal soon after the addition of a drop of the diluents mentioned earlier and warming to 100° F. It should be noted, however, that the wave-like motion manifest in preparations from the tail of the epididymis and the ampulla is rather of short duration and quickly stops probably due to partial drying of the viscous secretions. Addition of the above diluents at this juncture throws the sperm into maximal motility. When

secretions from the above-mentioned regions are spread thinly and examined directly with the naked eye, evidence of sperm motility can be obtained by the marked disturbance noticeable in the secretions.

It therefore appears that the sperm of the rat and the golden hamster are differentiated for motility very early in their development just as in the case of the other species already

Deer sperm from the head of epididymis, stained with Weigert's iron hæmatoxylin and safranin. Note the cytoplasmic cap at the anterior end of the acrosome and the cytoplasmic drop at the anterior end of the connecting piece, $\times 720$.

studied.¹⁻⁵ The ability for maximal motility, however, is attained by the time they reach the tail of the epididymis and it can therefore be presumed that the sperm complete their development and become physiologically mature by the time they reach this region. While the accessory secretions may have important functions to perform in sperm physiology it is doubtful whether these secretions have any

Motility of sperm from different regions of the male reproductive tract of the albino rat and the golden hamster before and after dilution with isotonic solutions

Site of collection of material	Albino rat		Golden Hamster	
	Motility before dilution	Motility after dilution	Motility before dilution	Motility after dilution
Testis ..	Very poor	Very poor	Very poor	Very poor
Head of epididymis	do	do	do	do
Body of epididymis	Poor	Poor	Poor	Poor
Tail of epididymis	Wave-like movement of short duration	Maximal motility	Wave-like movement of short duration	Maximal motility
Ampulla ..	do	do	do	do

specific stimulatory effect on sperm motility. Two important ways in which they appear to influence sperm motility seem to be by lowering the viscosity of the ampullar contents and by reducing the sperm concentration, these two factors being sufficient to induce maximal motility in the ejaculated semen. As Walton⁶ says, another important function of the accessory secretions appears to be to increase the bulk of the ejaculate and thereby render the urethral contractions more effective.

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Madras Veterinary College,
Vepery,
January 20, 1951.
Madras,

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VIGOUR IN GROUNDNUTS

AFTER harvest, the vegetative portion of the groundnut plant is often employed as a cattle feed or as a green manure. This wholesome practice is by no means common, since frequently the plant dries up at maturity, shedding most of the leaves. In an overall programme devoted to the improvement of this crop, consistent efforts have been maintained to improve the quality and quantity of the top growth thus providing a wider range for its utilization. Mention is made in this preliminary note of a little success achieved in this direction.

In many cases, individuals appear in F_2 having a greater vigour than either of the parents. In subsequent generations, this vigour is as often lost as retained. Usually these vigorous types set either poorly or bear pods of small size. Since 1939, a large number of these vigorous hybrid progenies have been under trial. The object aimed at is to obviate the defects of poor bearing and reduced pod size, while retaining the desirable feature of vigorous top growth.

Two of such hybrids (both bunchy in habit) have been under trial at the Visvesvariah Canal Farm, near Mandya, under dry land conditions, although there was extra sub-soil moisture. Both of them are hardy, resistant to drought, tolerant to *ticca* (*Cercospora* sp.) leaf spot, and retain the bulk of the leaves till

maturity. The yield of pods compares favourably with commercial types under cultivation. Of these H.G. 5 (G. 0195) a cross of Mysore Local and Spanish, is semi-erect and bears small pods. The pods are two seeded, the surface boldly reticulated and the kernels flesh coloured. The other hybrid between Virginia and Small Japan, H.G. 6 (G. 0689) is more bunchy in habit and bears medium sized pods. The two seeded pods are often deeply constricted and slightly misshaped. The kernels are flesh coloured. Their performance under field conditions is as follows:

Variety	Season	Pods per acre in lb.	Haulms per acre in lb.
H.G. 5	1949-50	1,250	16,000
	1950-51	1,100	13,200
H.G. 6	1949-50	1,350	15,000
	1950-51	1,200	12,350

The haulm yield obtained is two to three times more than ordinary.

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January 20, 1951.

SOME OBSERVATIONS ON THE GENICULATE AWNS OF *HETEROPOGON CONTORTUS* ROEM. & SCHULT.

THE awns of ball-forming variety of *Heteropogon contortus* Roem. & Schult. (*Andropogon contortus* Linn.) have the property of performing a right-handed torsion on being moistened. Drying-up produces a reverse movement. Reference to classical literature (Haberlandt) reveals a wealth of morphological and anatomical details bound up with a teleological explanation, viz., that it helps to push the seed into the soil. We have the following reasons to discount this:—

(a) It is possible for the awn to turn even when the seed is held fast.

(b) A number of such seeds were inserted vertically into glass tubes containing agar gels of various concentrations. The awns were then wetted, all the time keeping a horizontal microscope focussed upon the seed to measure its 'boring' movement (if any). In no case was any such movement observed. Neither did the reverse move-

ment tend to pull out the seed from the substratum.

Kerner and Oliver describe the feathery awns of *Stipa pennata* (feathery grass) which are also capable of performing the same movement but they place this factor as subsidiary. According to them, the majority of the boring action is performed by the wind oscillating the awn from side to side thus compressing the upward pointing stiff hairs on the seed which recoil and push the seed in. They further state that the rotating movement anchors the knee-shaped awn against other branches and levers the seed into the soil.

We tend to offer no further explanation—teleological or otherwise—in the present case, but merely wish to record the facts, in support of Huxley's statement that "the greatest tragedy in science is the slaying of a beautiful hypothesis by an ugly fact".

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February 20, 1951.

THE PRONEPHROS OF *APLOCHEILUS* *MELASTIGMA* (McCLELLAND)

GOODRICH¹ has observed that it is a remarkable fact that the pronephros remains functional in some adult Teleosts, like *Fierasfer*, *Zoarces* (Emery²) and *Lepadogaster* (Guitel³). I have been studying recently the organogenesis of *Aplocheilus melastigma*, and I find in this species a persistence of a functional pronephros in the adult.

In well grown specimens of *Aplocheilus* a pair of prominent pronephric glomeruli are present on the median side of the anterior end of the definitive or mesonephric kidneys. The arterial connections of the pronephros are well developed and indicate its functional nature. A comparison of the condition obtaining in *Aplocheilus* with the description and illustrations given by Guitel³ for *Lepadogaster* confirms the view that the pronephros of *Aplocheilus* is functional. I have also studied for comparison the adult kidneys of other genera of fish, like *Ophicephalus* and *Therapon*, but in these there is no persistent pronephros.

In this context a few observations on the development of the pronephros in *Aplocheilus* will be relevant. Moghe⁴ has stated that there are two views regarding the origin of the pronephros. The pronephric tubules of *Aplochei-*

lus, of which there is only one pair, develop independently of the archinephric duct which is developed earlier. Maschkowzeff⁵ has traced the origin of the pronephros to the lower part of the nephrotome whose cells have become incorporated in the general body cavity, and finds that in the origin of the mesonephric vesicles the relation to the nephrotome is more distinct. Fraser⁶ points out that Maschkowzeff's 'interpretation is the correct one, though his explanation is not convincing'. In *Aplocheilus* there is convincing evidence for the origin of the pronephros from the nephrotome. In a transverse section of an early embryo of about 36 hours a distinct intermediate cell-mass, with a trace of coelomic space constituting a true nephrotome is present on either side. From an examination of serial sections of several early embryos I find that the 'Anlage' of the pronephros in *Aplocheilus* arises from a distinct nephrotome, and the development of the kidneys of Teleosts is not therefore aberrant but falls in line with that of other Vertebrates. Further work is in progress.

My thanks are due to Prof. R. V. Seshaiya for guidance in my work.

Zoology Dept., K. RANGARAJAN.
Annamalai University,
Annamalainagar,
March 10, 1951.

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EFFECT OF TANNERY WASTES ON SOIL CONDITIONS AND PLANT GROWTH

TANNERY wastes are generally stored in settling ponds and, after a period of sedimentation and fermentation, they are discharged into the nearest watercourse or on land. In regard to the effects of tannery wastes on soil conditions and plant growth, there is practically no information.¹ Recently, we have carried out some studies on these aspects and the observations are briefly described below.

The liquid wastes from a fair-sized tannery near Madras have been, over a period of about 20 years, run into basins scooped out of earth spread over an area of about 2½ acres adjoin-

ing a stretch of paddy fields and the main irrigation channel from a tank in the neighbourhood. The effluent is allowed to accumulate and stagnate in such ponds and is sometimes, particularly during the rainy season, allowed to overflow, provision not having been made to treat the material and to dispose it of satisfactorily. Continued stagnation of the wastes causes considerable putrefaction giving rise to gases, such as H_2S ; and the overflow of the material causes heavy incrustations of salts and organic matter around the basins. The effluent basins are situated on a higher level in relation to the agricultural land (sandy loam with low water-holding capacity) and are very close to the latter (being separated by a bund and the irrigation channel), thus causing considerable seepage of the waste material into the adjacent land.

The soil in the area (about 92 acres covering three-fourth of a mile down the tannery effluent basins) has steadily become infertile, some acres of the affected belt of land having completely lost their productive capacity and the others partially. Whitish patches (mostly salts, e.g., $NaCl$) and blackish flakes (mostly organic matter) both traceable to tannery wastes may be noticed on the soil surface. Characteristic saline vegetation, e.g., growth of salt bushes and nut grasses, may also be seen. Germination of paddy on the fields is very unsatisfactory and in the case of the rice plants that come up the grain formation and the quality of grains are poor. Heavy manuring of these fields has had practically no beneficial effect on plant growth and crop yields. At the same time, satisfactory crop yields are obtained from the adjoining fields containing the same type of soil.

A large number of samples of soils and sub-soil waters from these two contiguous belts, fertile and affected, of the farm-land were examined. One set of results are given in Table I. The tannery effluent had pH values generally ranging between 8.6-10.9, and its composition varied (parts per 100,000): total solids, 1054.4-2294.8; loss on ignition (organic matter), 40.4-124.8; residue on ignition (mineral matter), 1014.0-2170.0; SiO_2 , 5.6-17.2; $Ca(HCO_3)_2$, 6.9-22.7; $Mg(HCO_3)_2$, 8.4-178.1; $NaHCO_3$, 66.8-353.5; Na_2CO_3 , 46.9-111.9; Na_2SO_4 , 15.4-299.1; $NaCl$, 547.1-1903.0; Cr, 0.08-0.33; As, traces.

The sub-soil water from the affected area had a pH value of about 8 and had the following composition (parts per 100,000): total solids, 958.4; loss on ignition (organic matter), 36.8; residue on ignition (mineral matter),

921.6; SiO_2 , 16.0; $Ca(HCO_3)_2$, 111.5; $CaSO_4$, 15.3; $MgSO_4$, 32.0; Na_2SO_4 , 130.0; $NaCl$, 537.5.

TABLE I

	Fertile area		Affected area	
	0-12"	12"-30"	0-12"	12"-24"
<i>Mechanical composition of soil (%) :</i>				
Coarse sand ..	54.1	44.0	48.6	45.9
Fine sand ..	20.5	23.5	23.5	12.8
Coarse fraction ..	74.6	67.5	72.1	58.7
Silt, fine silt and clay	25.4	32.5	27.9	41.3
<i>Physical characteristics :</i>				
Maximum water-holding capacity (%)	37.7	47.1	24.1	— *
Pore space (%) ..	40.7	46.8	28.5	— *
<i>Exchangeable bases :</i>				
(in milli-equivalents)				
(a) Sodium & potassium	0.7	0.4	9.5	11.7
(b) Total exchangeable bases	7.1	10.5	18.7	20.8
<i>Degree of alkalisation (%) :</i>				
Ex. $Na + K \times 100$	9.9	3.8	50.8	56.2
Total exchange capacity				
<i>Water extracts of soils (1 : 5) :</i>				
(parts per 100,000)				
Total solids ..	8.8	7.6	130.2	63.4
Mineral matter ..	8.3	7.4	123.4	61.8
$NaHCO_3$..	nil	nil	14.9	24.2
Na_2CO_3 ..	nil	nil	1.4	2.3
Na_2SO_4 ..	nil	0.4	20.2	11.1
$NaCl$..	2.6	2.8	83.2	17.0
Cr ..	nil	nil	Traces	Traces
As ..	nil	nil	Traces	Traces

* Resisted wetting in spite of being left in contact with water layer for over 27 days.

The above observations show that as a result of impounding the waste waters from the tannery close to the arable land, the salts, including toxic substances, from the waste materials soak through the soil and adversely affect the composition of the soil and the conditions for plant growth. The detailed paper will be published elsewhere.

Our thanks are due to Dr. V. Subrahmanyam and Mr. C. V. Ramaswamy Iyer for their valuable suggestions in the course of the work.

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Science, Bangalore, S. C. PILLAI.
May 2, 1951.

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A NOTE ON THE OCCURRENCE OF MONOSTACHOUS INFLORESCENCE IN *ELEUSINE INDICA*, GAERTN.

Eleusine indica, Gaertn., is a tufted annual grass, with a wide distribution in the tropics of the East, ascending up to about 6,000 feet above sea-level. In the genus *Eleusine*, Gaertn., the inflorescence is described to be polystachous, consisting of two to several digitate capitate or whorled spikes.^{1,2,3} In *E. indica* Ranga Achariyar⁴ describes: "The spikes are elongate, digitate 2 to 7, 2 to 5 inches long, all in a terminal whorl and sometimes with one or two lower down."

In August 1950, I collected from the area of the Rangoon University campus a number of specimens of what appear to be *E. indica*, but bearing only solitary spikes. Plants bearing such monostachous inflorescences were found growing along with others bearing the usual polystachous type of inflorescence. It was further noticed that in certain specimens, some of the inflorescences consisted of solitary spikes, while others showed two or more spikes. The spikelets in each case were carefully dissected and examined, and no difference was noticed between the monostachous and the polystachous types. Seeds from the two types have been separately collected, and it is planned to test in the following growing season whether the types breed true as regards their inflorescence character. Monostachous types were subsequently seen to occur fairly frequently in other parts of Rangoon as well, indicating that the condition is by no means exceptional.

To my best knowledge, the occurrence of monostachous inflorescence in any of the species of *Eleusine* has not previously been recorded.

The specimens of *E. indica* showing monostachous inflorescences are deposited in the Herbarium of the Rangoon University Biology Department.

Dept. of Biology, K. R. RAMACHANDRAN.
Rangoon University,
March 5, 1951.

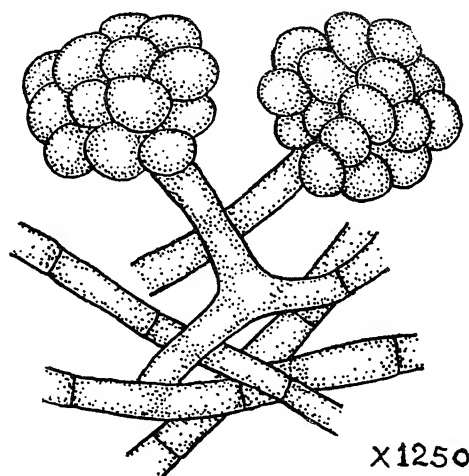
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AEGERITA WEBBERI ON SCALE INSECTS

ON scale insects (*Aleyrodes* sp.) infesting the leaves of *Holarrhena antidysenterica* Wall., growing in the Botanic Garden, Benares Hindu University Campus, an entomogenous fungus

was collected and identified as *Aegerita webberi* Fawcett. Popularly known as "brown mealy-wing fungus", it has been shown by Fawcett¹ to be of considerable economic importance in the biological control of the scale insects on citrus. The insects on *Holarrhena* were found killed to the extent of 80 to 100 per cent. Unlike as in infection by *Aschersonia* sp., which occurs frequently on scale insects, the stroma of *A. webberi* is compressed, flat, smooth, and imparts a deep brownish-black appearance to the insects.

Microscopic examination revealed that the mycelium spread from the base of the stroma forming a hypothallus. These filamentous hyphae were septate and colourless or tawny-brown with age. The sporodochia were borne on the hyphal strands, bearing aggregation of inflated cells (Fig. 1). Fawcett has shown the



extension of the hyphae to considerable distances on the leaves, bearing the clusters of sporodochia. Considering the degree of mortality inflicted by *A. webberi* on scale insects, this fungus may advantageously be used for the biological control of scale insects (particularly *Aleyrodes* sp.) in India.

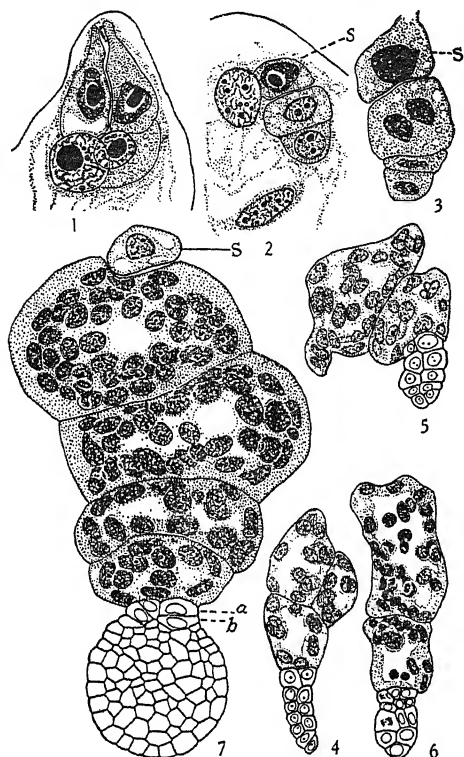
College of Agriculture, M. S. PAVGI.
Benares Hindu University,
April, 1951.

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ENDOSPERM AND EMBRYO DEVELOPMENT IN *CUSCUTA REFLEXA* ROXB.

ALTHOUGH the embryology of *Cuscuta* has been studied by some previous workers,^{1,2} the peculiarities found in *C. reflexa* are considered to be worthy of record.

After fertilisation the oospore and the primary endosperm nucleus enlarge (Fig. 1) and divide almost simultaneously. Fig. 2 shows a



FIGS. 1—7

Fig. 1. Upper part of mature embryosac showing oospore, two synergids and primary endosperm nucleus. $\times 288$. Fig. 2. Two-celled pro-embryo and two free endosperm nuclei; *s*, persisting synergid in this and some of the subsequent figures. $\times 288$. Fig. 3. Three-celled stage with binucleate basal cell. $\times 288$. Figs. 4 to 6. Enlarged multinucleate suspensor cells and five to six tiers of cells in the pro-embryo. $\times 133$. Fig. 7. Globular embryonal mass connected to the row of four suspensor cells by two tiers of cells, *a* and *b*, the uppermost suspensor cell shows 42 daughter nuclei. $\times 133$.

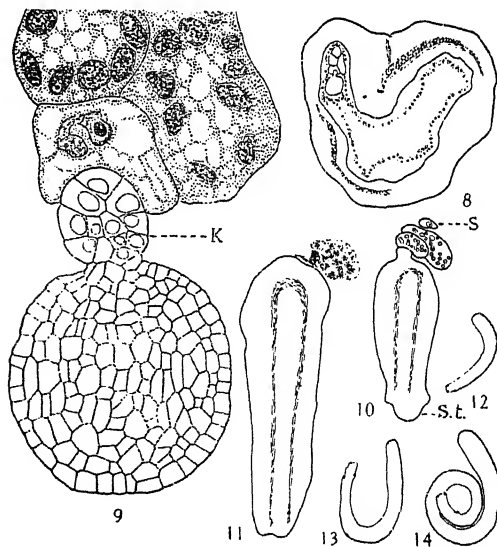
two-celled pro-embryo and two free endosperm nuclei in the upper part of the embryosac. Repeated free nuclear divisions result in a large number of endosperm nuclei, wall formation taking place much later (Fig. 8). An interesting point is that one of the synergids persists until a very late stage and is probably haustorial (Figs. 2, 3, 7 and 10, *s*).

Both the cells of the pro-embryo divide simultaneously resulting in a three-celled stage consisting of the larger vacuolated binucleate basal cell, a middle cell and the terminal cell (Fig. 3). The pro-embryo soon shows five to six tiers of cells besides the suspensor (Figs.

4 to 6). Anticlinal and periclinal divisions at the tip result in a globular mass of cells. Above these are two to four highly vacuolate and multinucleate suspensor cells (Figs. 4 to 8). Their nuclei divide mitotically and as many as 42 daughter nuclei have been counted in a single cell (Fig. 7). Thus the suspensor forms an aggressive haustorium comprising nearly three-fourths of the total length of the embryo (Fig. 7).

Two tiers of cells form a short neck between the suspensor and the globular mass of embryonal cells (Fig. 7, *a* and *b*). This develops into a knob-like projection pushing into the suspensor cell lying immediately above it (Fig. 9, *k*). Eventually with the further enlargement of the embryo proper the knob as well as the suspensor cells disintegrate and form a dense mass at its micropylar end (Fig. 11).

During its further growth the embryo becomes twisted and spirally coiled around itself (Figs. 12 to 14). The provascular strands and the stem tip can be identified at an early stage (Fig. 10, *s. t.*), but in accordance with the condition in many other parasites no cotyledons are distinguishable. Minute protuberances are seen on the hypocotyl and the stem tip which appear to be scale leaves but I have not yet followed their further development.



FIGS. 8—14

Fig. 8 L. s. ovule showing vascular supply reaching far up into the integument. $\times 9$. Fig. 9. Enlarged view of embryo shown in Fig. 8; note knob-like projection, *k*, pushing into the adjacent suspensor cell $\times 133$. Figs. 10 and 11. Elongated young embryo with stem tip, *s. t.*, already differentiated and suspensor cells crushed. $\times 30$. Figs. 12 to 14. Young and mature embryos, $\times 3$.

Since the nucellus is absorbed early there is no perisperm but the endosperm which becomes cellular persists in the seed. In the testa the epidermis is followed by a layer of smaller cells. The cells of the third and occasionally the fourth layer are radially elongated and have prominent nuclei. Finally there are ten to twelve layers of thin-walled cells of which the inner are crushed due to the enlargement of the embryo-sac. The vascular supply reaches far up into the integument and consists of prominent tracheids with spiral thickenings (Fig. 8).

I have pleasure in expressing my indebtedness to Prof. P. Maheshwari for his help.

B. M. JOHRI.

Dept. of Botany,
University of Delhi,
April 21, 1951.

1. Fedorischuk, W., *Planta*, 1931, **14**, 94-111. 2. Smith, B. E., *Jour. Elisha Mitchell Sci. Soc.*, 1934, **50**, 283-302.

BACTERIAL SOFT-ROT OF PEAS

IN the winter of 1949, green peas were found to be affected with soft-rot in the Delhi markets. The diseased pods always yielded colonies of a greyish-white bacterium. This bacterium, after purification by single-colony-culture method, was inoculated into healthy pods of peas by the procedure followed by Townsend (1904) when symptoms identical with the natural infection were produced. The pods showed yellow discolouration from outside but seeds within were completely transformed into a soft mushy bacterial mass which emitted foul odour. The organism was also found to infect potatoes, carrots, cucumber, tomato, chillies, radish, beet, brinjal, cauliflower and several other vegetables. Bacterial soft-rot of peas was found in occasional lots affecting 2 to 5 per cent. of the stock on the Chicago market in 1936 by Ramsey (1937).

Morphology.—The bacterium is a short rod with rounded ends, occurring singly or in pairs, occasionally in chains; actively motile by peritrichic flagella; Gram-negative, non-capsulated, non-spore forming, and not acid-fast. The size of the cells is $3.49 \times 0.76 \mu$ (negative staining).

Cultural Characters.—On nutrient agar slants the growth is moderate, spreading, raised, entire, moist-glistening and dirty-white in colour. Growth in nutrient broth is abundant with the formation of pellicle and abundant flaky sediment. Colonies on the surface of potato-dextrose agar plates are circular, elevated, smooth,

glistening, have sharp margins and pale olive-grey colour, and with no distinctive odour. On potato cylinders the growth is profuse, shining and creamy-white. The pathogen grows on media with pH ranging from 5.0 to 9.0, the best growth occurring at pH 7.0. The optimum temperature for growth is between 20° to 35° C., maximum 45° C., and minimum 4° C. The thermal death point lies close to 55° C.

Physiological Characters.—The pathogen is a facultative anaerobe, nitrate reducer but failing to produce ammonia, milk and litmus curdler with acid reaction and no peptonization in the latter. In tryptophane broth, hydrogen sulfide is not produced even after 15 days' growth. Ehrlich-Bohme method shows positive but feeble reaction for indole. Starch is not hydrolyzed. The isolate further gives negative reaction to M.R. and V.P. tests and requires from 13 to 22 days to liquify gelation. Acid without gas formation takes place from dextrose, lactose, sucrose, maltose, mannitol, glycerol, levulose, raffinose, arabinose, and xylose. The carbon source media, respectively, were prepared by adding 2 per cent. by weight of the designated compound, before sterilization, to nutrient broth containing 3g. of beef extract and 5g. of peptone per litre.

Identity.—The bacterium causing rot of green peas herein described appears to belong to the group of intermediates mentioned by Stanley (1938), who reports that 44.0 per cent. of cultures isolated from soft-rots are intermediate between *Erwinia caratovora* (Jones) Holland and *Erwinia aroideae* (Townsend) Holland. It resembles the two pathogens in its morphological and cultural characters, and most of the physiological characters. It agrees with *E. caratovora* in failing to produce hydrogen sulfide and ammonia, diastase negative, and in positive test for indole. It is like *E. aroideae* in its lack of gas formation from the carbohydrate media and in the negative reaction to M.R. and V.P. tests. The pea isolate is, however, unlike both *E. caratovora* and *E. aroideae* in being a slow gelatin liquifier (13 to 22 days) and in having slightly higher thermal death (55° C.).

Thanks are due to Dr. R. S. Vasudeva for helpful suggestions and criticism.

Div. of Mycol & Plant Path., M. K. HINGORANI.
Indian Agric. Res. Institute,
New Delhi,
April 26, 1951.

- [1. Ramsey, G. B., *Plant Dis. Rept. Sup.*, 1937, **101**, 91.
2. Stanley, A. E., *W. Va. Agr. Exp. Stat. Bull.*, 1938, p. 287. 3. Townsend, C. O., *U.S. Dept. Agric. Bull.*, **60**, 1904 60,

REVIEWS

Radio Operating Questions and Answers. By J. L. Hornung. Tenth Edition. (McGraw-Hill Book Co., Inc., New York, N.Y.), 1950. Pp. 588. Price \$4.00.

This is a book designed to meet the requirements of the students appearing for the radio telegraph and telephone operators' license examinations conducted by the Federal Communications Commission of U.S.A. In this country it will be found equally useful to students who have to face the *viva voce* examinations of the various Polytechnics in Radio Technology and to those that take the Radio Operators' Certificate Examinations.

The questions and answers cover basic radio laws, theory and practice, radio telegraphy and telephony and aircraft radio. A special problem section which deals with problems relating to antenna systems, loran and radar has been added to this new 10th edition. That something like 2,000 questions have been answered in about 500 pages should make it clear to the student that this book is intended to serve only as a guide to study and not as a text-book.

A work that is expected to be consulted almost solely by examinees should avoid mistakes such as " λ = wavelength in metres per second" on p. 90, " $X_c = \frac{10^6}{2fC}$ ohms" on p. 102,

"Turns ratio = $\frac{Z_1}{Z_2}$ " on p. 216, etc. Answers

to Q. 4.114 and Q. 4.145 bear no relation to the questions. The solution to problem 36 as indicated on p. 533 is likely to convey the wrong impression that the pulse repetition period is the ratio of the peak pulse power to the average power and is independent of the pulse duration. The answer to problem 28 (p. 529) is misprinted as 1,199-180 KC/sec. instead of 1,199-280 KC/sec. Barring a few errors of this type, the book can be recommended to the class of readers it is intended to serve. R. L. N.

Introduction to Statistical Analysis. By W. J. Dixon and F. J. Massey. (McGraw-Hill Book Company, Inc.), 1951. Pp. 370. Price \$4.50.

This book is a welcome change from the series of books that have been appearing for some time on specialised aspects of statistical theory and application. Covering a variety of topics from elementary ideas of statistical populations, measures of central tendency, dispersion, etc., to advanced concepts of statistical

inference such as testing of hypothesis, confidence intervals, sequential and non-parametric tests, the book presents the logical problem in each case and the computational methods of solution without any attempt to justify the formulæ used. While a routine practical worker may feel happy that he is spared of all the mathematical analysis, a student of statistics may genuinely complain against the complete absence of mathematics. For instance, the authors set up a 90 per cent. confidence for σ^2 by considering the lower 5 per cent. and upper 5 per cent. values of χ^2 . Why this way? Why not consider the 6 per cent. point at the lower end and the 4 per cent. at the upper end? In fact there is satisfactory answer to this problem and the way the authors state does no justice to the problem of interval estimation of σ^2 .

The authors define variance by the sum of squared deviations divided by $(N-1)$. There is no particular virtue in such a definition and this might lead to a confusion of terminology. The above statistic may be specifically mentioned as an unbiased estimate of the variance in the population which might consist of a finite or an infinite set of elements.

As a general treatise on the scope of statistical methods this book is useful for the beginners as well as the professional statisticians with all the references, glossaries, discussion questions, class exercises and problems it contains. Some added attractions of this book are a description of the punched card technique in large scale computations and a number of appendices containing useful numerical tables.

C. RADHAKRISHNA RAO.

Industrial Applications of Gasfilled Triodes (Thyratrons). By R. C. Walker. (Published by Chapman and Hall, London, W.C. 2). Pp. ix + 325. Price 40 sh. nett.

This book is a welcome addition to the scanty literature available on the subject. It deals with the hot cathode grid-controlled thyratrons, their operating characteristics and the underlying physical theory. Methods of control by grid amplitude and phase change are explained in detail. Considerable attention is given to industrial applications. Cold cathode triodes, ignitrons, photoflash bulbs, etc., are also dealt with.

The book is divided into eight chapters. The hot cathode gas-filled valve, the gas-filled

tetrode, the basic circuits using such triodes, applications of the gas-filled triode as a switching device and in relay circuits, indicating, controlling and measuring devices, voltage and current regulator applications and commutating devices come up for treatment in separate chapters. The last chapter is devoted to other types of grid-controlled gas-filled valves. Each chapter is a well balanced account of the topic under discussion. The treatment is clear and the information is mostly accurate.

The printing and get-up of the book are of the high standard we have come to expect of the publishers. There are several diagrams in the book. All of them are neatly drawn and well reproduced. There are excellent photographs of typical tubes to explain their constructional features. There is a very valuable and well selected bibliography at the end of each chapter. This increases the utility of the book to those interested in further investigations.

The book can be strongly recommended to electrical and communication engineering and physics libraries. The honours student will find much that is valuable to him in the book.

S. V. CHANDRASHEKHAR AIYA.

Science in Fisheries. By Lorne Manchester.

(Reprinted from the *Canadian Geographic Journal*), Department of Fisheries, Ottawa, Canada, 1951. Pp. 23. Photographs 34.

This attractively illustrated booklet briefly describes how scientific researches conducted for over half a century have contributed to the development of fisheries in Canada. In view of the various fishery research programmes now in operation under the auspices of the Indian Union and State Governments and the scepticism that is often expressed regarding the utility of such work, this publication will be of special interest to readers in India.

The booklet sets forth a very satisfactory and encouraging record of achievements in fishery development made by the Fisheries Research Board of Canada, which consists of fifteen members drawn from the Universities, Department of Fisheries and the Fishing Industry.

The most striking contribution made by the Board appears to be the exploratory surveys which led to the discovery of new resources such as the rich fishery of the Great Slave Lake in N.W. Territories, the rosefish stocks of the Hermitage Bay, new supplies of American plaice and cod down the eastern edge of the Grand Bank, a new source of supply of the Winnipeg goldeye in Lake Claire, etc. On the biological

side, the studies on the flounder, Pacific and Atlantic salmons, lobsters, oysters, seals, etc., have enabled the development and successful management of their fisheries. The intensive study of catch fluctuations have served to provide a very adequate management policy resulting in a maximum sustained fishery. Researches on oysters led to oyster culture and investigations on seaweeds have contributed to development of the Irish moss industry.

Technological research, both for the improvement of the fishing gear and the full utilization of fish products were conducted by the Board and its achievements in this line are varied and interesting. The development of flounder dragging, experimental fishing with different types of nets and the detection of fish schools by echo sounders aided by other electrical devices in mid layers of water where their existence was unknown, are some of the important items mentioned. Investigations on fish processing have been responsible for improvements in preservation methods, especially refrigeration, salt-fish drying, canning and recovery of edible flesh from fish wastes; and these have helped in saving large sums of money to the industry. Several bye-product industries, such as the preparation of albumin from fish as an egg-white substitute and the production of peptones from fish waste, have been built up. The "animal protein factor" of different Canadian fishes and fish products have been determined to demonstrate their food value. Other important contributions are the development of a new method by which 85 per cent. of the oil from cod livers could be extracted, the preparation of a highly palatable margarine oil, the development of processes for obtaining protamine from salmon milt, insulin from halibut, lingcod and whales, and decolourizing carbon from herring scales.

A notable fact is that the results of the Board's researches are applied in the field of development through the operation of the Department of Fisheries and made freely available to the fishing industry, who appear to have been quick and ready in making use of the findings. Many of the items of research have direct applied value to the industry. But a few schemes, especially those concerning biological researches, have a long-range outlook. A correct approach has been made in every branch with a clear conception of the objectives, and it is surely wise planning that has enabled a comparatively small group of scientists to make such outstanding contributions to the development of the industry in Canada.

T. V. R. PILLAY.

Problems in Chemistry for Advanced Students.

By Messrs. Y. G. Lele, G. B. Kolhatkar and K. R. Jog. (Dastane Brothers' Home Service, Poona), 1950. Pp. 196 + 96. Price Rs. 5.

The book is a re-issue of the authors' *Problems in Organic Chemistry and Problems in Physical Chemistry* in one volume, and is bound to be useful to students of Chemistry of the B.A., B.Sc. and M.Sc. courses in our Universities.

Adaptation and Origin in the Plant World.

By F. E. Clements, E. V. Martin and F. L. Long. (Waltham, Mass: The Chronica Botanica Co.), 1950. Pp. 332. Price \$6.00.

This exquisite Plant Ecological treatise is quite unlike the usual text-books appearing on the subject. The book summarises the results of a long-range project on plant adaptation and origin conducted by the late Drs. F. E. Clements and F. L. Long with the collaboration of Dr. E. V. Martin at the Santa Barbara (sub-tropical marine) and Pikes Peak (Alpine) experimental gardens and laboratories. Thoroughness of planning this large-scale experimentation is seen in every chapter of the book and is typical of all field experimental work conducted in American Ecological laboratories. Some of the important chapters in the book are: Behaviour, Factors and Control, Functions, Ecogenesis, Controlled Experiments, Experimental Morphology and Phylogeny. Of particular interest to research workers in this country would be the simplicity of the instrumentation and the very elaborate results derived from that simple lay-out. Most of the physiological set-up used in these investigations is what could be normally rigged up in many Indian Botanical Laboratories and this book clearly sets one thinking on the need to overcome complacency and start vigorous schools of research in Plant Ecology in many University centres in India.

The strong point of the publication is its fine get-up and splendid illustrations, credit for which goes to Mrs. E. S. Clements. There are a few weak spots, however, the most important of which relates to the lack of any suggestion on the need for using statistical interpretation of the various field data on speciation, growth-rate and transpiration measurements, chemical and physical soil analyses, etc. There are obvious disadvantages when statistical interpretation of voluminous data is not resorted to, the most important of them being the cautious conclusions that one is inclined to draw. Although this cautious attitude is not evident in this book mainly because of the other advan-

tages the authors have had, viz., elaborate nature of the planning and the long period over which the observations have been made, yet the possibilities of obtaining a more uniform interpretation of the various experimental results by applying statistical methods cannot be ruled out.

There should be no hesitation in recommending this book to all botanical workers engaged in routine teaching as well as those interested in plant ecological research and general problems of morphogeny, phylogeny and evolution.

T. S. S.

Scientific and Learned Societies of Great Britain.

A hand-book compiled from Official Sources. (George Allen & Unwin, Ltd.), 1951. Pp. 227. Price 30 sh. nett.

Previously called the *Year-Book of Scientific and Learned Societies*, this hand-book makes a welcome return after eleven years. It is now arranged in two parts.

Part I, included for the first time, deals with the organization of scientific research in Great Britain and gives the names and addresses of the main research establishments administered by the Department of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council, and the Research Association. A valuable chart is included, showing the relationships which exist between bodies engaged upon scientific research in Great Britain.

Part II follows the previous editions and gives full details of more than 600 societies in Great Britain, including the objects and publications of the society concerned, the membership subscriptions, meeting times and principal officers. The societies are listed alphabetically, and are classified.

Register of Scientific and Technical Personnel

The second part of the first volume of the *National Register of Scientific and Technical Personnel* has just been published by the Council of Scientific and Industrial Research. It contains the names of engineers—civil, electrical, mechanical, chemical, mining, marine, automobile, aeronautical and communication—who furnished particulars for registration after the issue of the first part in September, 1949.

The information given in this register includes in brief outline, academic and professional qualifications, practical experience—nature and scope, address, present occupation, nature of employment, etc., of qualified engineers in India. At the end of the volume is

given a classified statement of the numbers of engineers under different categories and a brief account of Engineering Organizations and Societies and Technical Education in India.

Annals of the New York Academy of Sciences:
Volume 51, Article 6. Pages 1001-1122: *Methodology and Techniques for the Study of Animal Societies*. New York, 1950.

The present publication is a collection of the eleven papers presented at a symposium on Methodology and Techniques for the study of Animal Societies promoted jointly by the New York Academy of Sciences and the New York Zoological Society, in the fall of 1948.

Some idea of the nature and scope of the papers can be gathered from their titles:—General plans and methodology for field studies of the naturalistic behaviour of animals by C. R. Carpenter; The social behaviour of dogs and wolves: an illustration of sociobiological systematics by J. P. Scott (page 1); The relationship between observation and experimentation in the field study of behaviour by T. C. Schneirla; Measurement of some physiological reactions to Arctic conditions by Laurence Irving; Instruments for the measurement of physiological reactions of unrestrained animals by J. L. Fuller; Effects of nutrition and diseases on experimental animals by L. J. Goss; A study of the phylogenetic or comparative behaviour of three species of grouse by J. W. Scott; Social life and the individual among vertebrate animals by N. E. Collias; The isolation of factors of learning and native behaviour in field and laboratory studies by B. F. Riess; Techniques for observing bird behaviour under natural conditions by J. T. Emlen; The study of wild animals under controlled conditions by J. B. Calhoun.

Anyone expecting in this work a simple manual on the study of animal societies will frankly be disappointed as it is rather a collection of serious essays on various aspects of the subject by leading workers in different fields and on different groups of animals which form the foundation for a new discipline called sociobiology. What part sociobiology would play in the coming years will be watched with no ordinary interest by thinking men everywhere.

Barring a few minor blemishes—such as illy-conceived for ill-conceived on p. 1094, line 11, presumable for presumably on p. 1096, line 20 and 20 feet for 100 feet in the legend below

diagram in Fig. 1, p. 1114—the publication is excellent. The summary and bibliography of significant references accompanying most of the papers, add to its usefulness. The book can be warmly recommended to any one interested in such studies.

N. G. P.

The Biochemistry of Fish. *Biochemical Society Symposia* No. 6, 1951. (Published at the University Press, Cambridge). Pp. 105. Price 12 sh. net.

The introduction by Prof. R. A. Morton stresses the importance of research on the applied biochemistry of fish. In the first paper, the comparative aspects of fish biochemistry with particular reference to nitrogen metabolism and blood composition of the marine and fresh-water fish as well as teleost and elasmobranch species of fish have been discussed. The paper on proteins of fish is of particular interest in view of the recent researches on the chemistry of muscular contraction. Fish as a class belong to a lower order of vertebrates and it may be expected that the chemical processes accompanying muscular contraction in fish muscle are less complex than in the mammalian muscle. In this paper, the recent work carried out on the fractionation of various proteins in fish muscle and some of their physicochemical properties have been discussed. The chapter on the nitrogenous extractives deals with the differences in the composition of various species of fish with respect to the non-protein nitrogen. A knowledge of the nitrogenous extractives is of importance in the study of nitrogen metabolism as well as spoilage of fish. The paper on the chemistry and metabolism of fats by Dr. Lovern, an eminent worker in this field, discusses the relationship between the dietary and depot fats of a number of species of fishes. The depot fats of fish are more complex in composition than those of terrestrial animals. The carotenoids of fish have been discussed in another paper by T. W. Goodwin. Marine zooplankton seem to be the main source of vitamin A in marine fish while freshwater copepods seem to be source of vitamin A₂ in freshwater fishes.

This monograph is well printed and contains valuable information for those interested in the biochemistry of fish. Its value would, however, have been enhanced if the discussions on the individual papers had also been recorded.

G. N. SUBBA RAO,

SCIENCE NOTES AND NEWS

Jussieuva suffruticosa

Sri. M. S. Chandrasekhar, Curator, Botany Section Government Museum, Madras, writes as follows:—

On the crest of the Bannerghatta Hill (4,480 ft. above sea-level) near Bangalore, *Jussieuva suffruticosa* was found growing in association with *Scirpus articulatus* on dry silt. Such occurrence of this plant on dry soil appears to be unpublished hitherto.

Research Degree Awards

On the recommendation of a Board of Examiners consisting of Prof. Eric K. Rideal and Prof. S. K. Bhattacharya, Sri. S. Vedaraman, M.Sc., of the Indian Institute of Science, Bangalore, has been awarded the Ph.D. Degree of the University of Bombay, for his thesis on "Adsorption Studies on Catalysts of Industrial Importance".

On the recommendation of a Board of Examiners consisting of Professors A. I. Vogel, H. Vincent, A. Briscoe and E. K. Rideal, Sri. M. Narasimha Sastry, M.Sc., has been admitted to the Doctor of Science Degree of the Andhra University for his thesis on "Newer Methods in Volumetric Analysis."

Reviews of Pure and Applied Chemistry

The Royal Australian Chemical Institute has begun publication of a new quarterly journal, "Reviews of Pure and Applied Chemistry," replacing the earlier "Journal and Proceedings". The first number, issued in March, contains reviews and general articles covering important aspects of pure and applied chemistry.

Annual Prize for Popularisation of Science

An international annual prize of 1,000 pounds sterling for the best works of scientific popularisation has been established by Mr. M. B. Patnaik, an Indian Industrialist, and will be awarded under the auspices of UNESCO, bearing the name of *Kalinga*. In co-operation with the International Council of Scientific Unions, UNESCO, will draw up and publish the rules for competition for the prize; and the first award will be made in 1952.

Watumall Foundation Essay Contest

Watumall Foundation is offering seven prizes for the best essay on "Population Control

in Relation to Food in India" the highest prize being Rs. 3,000. Essays must be in English, not exceeding 3,000 words and must deal with the problem and its solution. They are to be submitted to Mr. J. Watumall, Kishore Buildings, Kalbadevi Road, Bombay 2, before August 12, 1951.

New Jute Pest

Fusarium, not hitherto known to be a jute parasite, has been detected to cause damage to jute plant recently at Tarakeswar (W. Bengal). Heavy wilting of jute plants was reported from Tarakeswar. The affected plants, on examination at the Agricultural Research Institute of the Indian Central Jute Committee, were found to have *Macrophomina* associated with *Fusarium*. Some specimens of the diseased plant gave *Fusarium* only on isolation. It now appears that *Fusarium* is an important soil-borne parasite of *Corchorus olitorius*.

ISCA Memoranda to UNESCO

The 60-page Memoranda recently issued by the Indian Science Congress Association in reply to a request by the UNESCO embodies reports on the following subjects: Energy and Power Resources of India; Science Clubs in India; Popularisation of Science through Books; and International Collaboration between Existing Associations for the Advancement of Science.

World Medical Association

The Annual General Assembly of the World Medical Association will be held in Stockholm in September of this year, when Dr. Dag Knutson, who is Assistant Physician at the Karolinska Hospital and President of the Swedish Medical Association, will take over the presidency from Dr. Elmer L. Henderson. It is expected that about 200 delegates and alternate delegates will be present at the meeting.

ERRATUM

Vol. 20, No. 4, p. 102, in the note on "Potato Pyrophosphatases",— Reference No. 5 should read as follows:

Pfankuch, E., *Z. Physiol. Chem.* 1936, **241**, 34.

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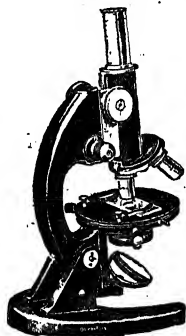
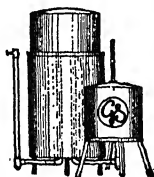
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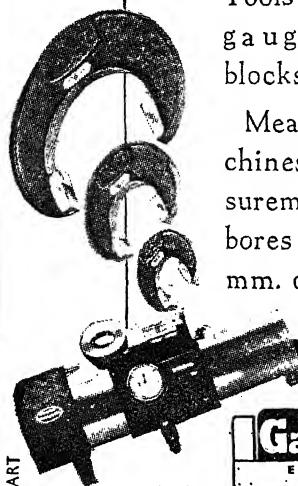
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THE NEED FOR BIOPHYSICAL RESEARCH

THE main trend of scientific research in the present century has been the progressive intermingling of various branches, which were formerly considered as independent. Thus, physical chemistry and mathematical physics were the earliest to be recognized as distinct fields of study, while biochemistry has now been in existence for a considerable period as a separate discipline. But the application of physical and mathematical methods on a large scale to biological problems is a recent development, resulting in the emergence of 'biophysics' and 'biometry'. It is obvious that major developments are likely to occur in these comparatively virgin fields, which serve as common grounds for different well-established disciplines.

In the past, a few biologists have been interested in the physical aspects of their subject, and physicists have applied their methods to the study of living organisms. Unfortunately, however, there has been no uniformity in the approach to biophysics, nor even a clear conception of its scope and potentialities. The problems concerning the development of biophysics as a separate field of endeavour have been ably treated in an article by R. W. Stacey and his views have been

discussed by a number of workers in another issue of *Science*.*

The term 'biophysics' may be used to cover broadly three types of studies: the physics of biological systems, the biological effects of physical agents and the use of physical methods in the study of biological problems. It is thus clear that biophysics covers a very large domain of knowledge, and that no logical and well-defined demarcation can be laid down between it on the one hand and the allied branches of physics and biology on the other. But there is no doubt that there exists at present a large area of no-man's-land between physics and biology, which would yield interesting results on exploration. For instance, there is an impressive volume of work waiting to be done on living matter at the microscopic, sub-microscopic and molecular levels. The worker interested in this phase would study tissue ultrastructure with the aid of physical instruments like the X-ray camera, the centrifuge and the electron-microscope. He would investigate the various properties of protoplasm like viscosity, elasticity, optical activity and

* "The Status and Development of Biophysics," *Science*, 1951, 113, 169, 617.

so on. The thermodynamics of living matter constitute another fundamental field of research, rich in exciting biophysical problems. Spectrophotometric analysis of biological materials may constitute a real contribution to our knowledge of the molecular patterns in the protoplasm and to an understanding of the real nature of life. The measurement of bioelectric phenomena may lead to a proper understanding of neural and mental processes.

Man now travels faster and farther, higher in the air and deeper in the ocean, than ever before. He is exposed to new physical influences by virtue of the invention of new weapons and machines. We must learn the effects of these physical agents on living matter and the biophysicist has a large part to play in such studies. The rapid advances in nuclear physics have led to new and important aspects of biophysical research, such as the tracer isotope techniques and the effects of nuclear radiations on living matter. Again, physical instrumentation forms a major portion of the projected activity of the biophysicist.

Perhaps the reason why many of these subjects have not been investigated in detail in the past is that one needs a background both of biology and physics for a proper appreciation of the problems. Whether we like it or not, there is a difference in the approaches of physicists and biologists in tackling their problems, and it is difficult for one trained in

one only of these disciplines to acquire the way of thinking of the other. There is obviously therefore, a need for the development of a special curriculum for training students who wish to take up biophysical research.

Researches in biophysics have been going on in other countries mostly through collaboration between workers in the two fields to which it is related. In some, as in France, regular courses of study are available in the subject. It is time that we in India too considered the possibility of affording courses, at the post-graduate level, to those who wish to take up research in this fascinating field. As a first step, summer courses may be given in the premier laboratories, to acquaint the biologists with the physical techniques that could be profitably used in their studies as also to familiarise the physicists with the basic concepts and ideas behind biological research. Workers in our country could expect to make significant contributions to this field, for it is still in the exploratory stage and not much spadework needs to be done in catching up with workers elsewhere as far as technique is concerned.

Let us therefore earnestly hope that active collaboration between workers in physics, chemistry and biology will soon be forthcoming from our universities and research institutions, to enable us to contribute our share to the field of biophysical research.

INTERNATIONAL CRYSTALLOGRAPHIC CONGRESS, 1951

THE SECOND INTERNATIONAL CONGRESS OF CRYSTALLOGRAPHY was held in Stockholm, from 27th June to 5th July 1951. More than 350 delegates from many countries attended the session. The three Indian delegates were Sir K. S. Krishnan, Prof. R. S. Krishnan and Mr. A. Verma.

Prof. A. Westgren, President of the Local Reception Committee, inaugurated the first plenary session with an address of welcome to the delegates. The Presidential Address was delivered by Sir Lawrence Bragg, the President of the Crystallographic Union. He gave a brief resumé of the history of the growth of X-ray crystal analysis starting from the pioneer work of von Laue and the two Braggs. He referred to the ever-increasing application of the techniques of X-ray crystallography in diverse branches of physics, chemistry, mineralogy, soil science, agriculture, biology and medicine.

The scientific meetings were divided into two sections, reading of papers and symposia. The contributed papers were broadly classified under the following heads:—order-disorder phenomena, various X-ray techniques, organic

structures, electron diffraction, crystal growth, martensite, instruments, neutron diffraction, ferro-electrics, inorganic structures, metal structures, symmetry computing aids, minerals, protein and related structures, cold-worked metals, random and deformed structures, diffuse scattering and others.

On the 4th and 5th July, symposia were held on the following subjects: (1) advanced techniques in structure determination and (2) electron diffraction in gases. During the final plenary session it was decided to hold the third General Assembly in the summer of 1954 either in Paris or in Holland, and the following were elected to the Executive Committee for the period 1951-54:

President: Prof. J. M. Bijvoet (Holland), *Vice-Presidents:* Prof. G. Hagg (Sweden), Prof. J. Wyart (France), *Secretary:* Dr. R. C. Evans (United Kingdom), *Editor:* Prof. P. P. Ewald (U.S.A.), *Ordinary Members:* Prof. J. D. Bernal (United Kingdom), Sir K. S. Krishnan (India), Prof. E. Onorato (Italy), and Prof. A. L. Patterson (U.S.A.).

THEORY OF THE CAPACITY PHENOMENA DISPLAYED AT MERCURY CAPILLARY ELECTRODES*

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(Indian Institute of Sugar Technology, Kanpur, India)

HEYROVSKY, SORM AND FOREJT¹ have described a new and interesting technique for the investigation of electrode kinetics which involves the study of oscillographic potential-time curves obtained by polarising the dropping mercury electrode with an alternating field. They found a peculiar phenomenon due to pyridine seemingly disagreeing with the ordinary run of polarographic experience. Pyridine is known not to be reducible in alkaline solutions² as it causes no wave on the polarographic current-voltage curves; yet, when added to an alkaline solution, it produces a marked effect on the oscillographic potential-time curve. There appears at a potential of about -1.5 V. (with reference to saturated calomel electrode) a well pronounced time-lag, which indicates a depolarisation process. Since, however, the occurrence of an electrolytic process at that voltage must be excluded from polarographic experience, the stay at that potential has been explained on the basis of sudden changes in capacity.

That this phenomenon is not due to electrolytic reduction of pyridine is suggested by the fact that the concentration of pyridine at which the time-lag is shown, is about 100 times as large as that required to show a similar time-lag for an electrolytic depolariser. A closer investigation of this phenomenon revealed that the ordinary polarographic charging current shows in the same solution and at the same potential a sudden increase in the current. These large changes in the current have been identified by Heyrovsky and co-workers as due to desorption occurring to a large extent at the voltage at which the polarographic wave occurs. It is the object of the present note to formulate a theory to explain the phenomenon quantitatively.

The adsorption of pyridine may be caused by its hydrophobic tendency in alkaline solutions. In an attempt to get away from water it tends to concentrate at the mercury-sodium hydroxide interface. This takes place relatively unhampered at the electrocapillary zero. When more negative potentials are applied to the dropping electrode, the charged mercury surface attracts water molecules by dipolar attraction and hence the adsorption of pyridine is diminished. The rate of change of current would be closely fol-

lowing the rate of change of adsorption consequent on the change of potential. As Heyrovsky and co-workers have pointed out, the changes in current are due to the changes in the capacity of the dropping mercury electrode. It is reasonable to assume, therefore, that the maximum slope of the current-voltage curve would occur at practically the same potential as wherein the maximum slope occurs in the adsorption-voltage curve.

The expression for the variation of adsorption with potential of the dropping electrode can now be formulated. Following Glasstone, Laidler and Eyring,³ we get:—

$$\frac{\theta}{1-\theta} = K_1 c e^{\epsilon/kT}, \quad (1)$$

where θ = the fraction of the surface covered by adsorbed molecules, c = concentration of pyridine, k = gas constant, ϵ = heat of adsorption, and T = absolute temperature. The effect of increasing the potential is to increase the attraction of water dipoles to the mercury surface which means that the heat of adsorption would get diminished with increased negative voltages beyond the electrocapillary zero. If ϵ_0 is the heat of adsorption of pyridine at the electrocapillary zero, it may be reasonable to suppose that in general the heat of adsorption is given by

$$\epsilon = \epsilon_0 - K_2 V, \quad (2)$$

where V is the numerical value of the applied negative voltage with reference to electrocapillary zero and K_2 is a proportionality constant. The equation accordingly becomes

$$\frac{\theta}{1-\theta} = K_3 c e^{-K_2 V/kT - \epsilon_0/kT}, \quad (3)$$

where $K_3 = K_1 e^{-\epsilon_0/kT}$

Differentiating, we get

$$\frac{d\theta}{dV} = -\theta (1-\theta) \frac{K_2}{kT}. \quad (4)$$

An examination of equation (4) shows that $\frac{d\theta}{dV}$ becomes maximum when $\theta = \frac{1}{2}$, if the concentration of pyridine is so high that at the electrocapillary zero θ is equal to or greater than $\frac{1}{2}$. (If, however, the concentration of pyridine becomes so low that θ is less than $\frac{1}{2}$, the maximum for $\frac{d\theta}{dV}$ occurs at the electrocapillary zero itself.)

* The authors wish to thank the Uttar Pradesh Scientific Research Committee for a grant on a scheme of 'Electrode Processes,' of which this work forms a part.

Putting $\theta = \frac{1}{2}$ in equation (3), we get

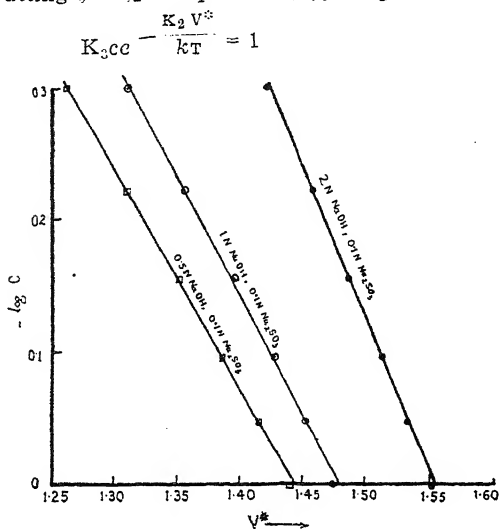


FIG. 1

where V^* is the potential corresponding to the inflection in the polarographic curve.

$$\text{Therefore, } V^* = \frac{kT}{K_2} \log K_3 + \frac{kT}{K_2} \log c. \quad (5)$$

This shows that V^* should be a rectilinear function of $\log c$. Fig. 1 gives the curves plotted on the basis of the data of Heyrovsky and co-workers.¹ An examination of the curves shows a satisfactory rectilinear relationship, as predicted by the above formulation.

Though this formulation is primarily for condenser current, it can also apply to the shift of the half-wave potentials of reactions hindered by the adsorbed pyridine, as for example the shift of the second wave of the polarographic reduction of oxygen.

1. Heyrovsky and others, *Czechoslovak Chemical Communications*, 1947, 12, Nos. 1-2. 2. Knobloch, E., (*Czech*) *Chem. listy*, 1945, 39, 54-60. 3. Glasstone, Laidler and Eyring, *The Theory of Rate Processes*, McGraw-Hill, 1941.

HINDUSTAN TRAINER-2

THE first step towards self-sufficiency in aviation, may be said to have been achieved recently when HT-2, the first Indian designed and built prototype aircraft, carried out its flight trials successfully.

The HT-2 is an all-metal, monoplane of 2,100 lb. gross weight, powered by a Gipsy Major 10 Engine of 145 rated horse power. Many special features have been incorporated in the design and construction of this aircraft which makes it superior to similar type of foreign aircraft in the market. The aircraft is all metal including the control surfaces, which reduces the maintenance cost in operation in varying Indian climatic condi-

tions. Secondly, the controls are operated by "push pull rods" instead of cables, thereby eliminating any lag and delay in the operation of controls. The aircraft is fully aerobatic, *unrestricted* for the total gross weight which is a feature very few trainer aircraft possess.

Except for the engine and the instruments, all the major components of this prototype are designed and manufactured at Hindustan Aircraft Factory. The design team was headed by Dr. V. M. Ghatage, Chief Designer of the factory, assisted by a few foreign-trained Indian aeronautical engineers and a group of engineers from the Indian Institute of Science.

SINDRI FERTILIZER FACTORY

SINDRI FERTILIZER FACTORY, which will start functioning in September, has a production target of 350,000 tons a year. This annual target is expected to be reached during 1953.

The factory has been planned in such a way that the outturn can be doubled by the installation of additional equipment. Alternately, it can also be expanded to produce different types of products such as nitric acid for India's chemical industry in general, ammonium nitrate or nitro-chalk as fertilizers, etc.

An experiment successfully carried out at Sindri regarding water supply is worth mentioning. This is the construction of an infiltration gallery to extract sub-surface water

running below the sands in the bed of the Damodar river during the hot season when the surface flow dries up. Tests have already proved that the infiltration gallery can yield between five and six million gallons of water a day.

Another feature of interest is that in the process of manufacture of 1,000 tons of ammonium sulphate per day, about 900 tons of calcium carbonate sludge are expected to be thrown up as a by-product. Plans are under the consideration of the Government of India for utilising this by-product as a raw material for a cement factory with an installed capacity of 300 tons per day of first class Portland cement.

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SCATTERING OF LIGHT IN WATER KEPT IN CONTACT WITH METALS

It is a matter of some practical importance to know whether and if so, in what form, metals go into solution when they are kept in contact with water. The problem was investigated by using the method of light scattering. The intensity and polarisation characters of light scattered transversely by dust-free, double-distilled water kept in contact with gold, silver, copper and brass were studied as a function of time.

Pure dust-free water is collected in a round-bottomed flask of 250 c.c. capacity and the metal under test is placed in the bottom of the flask and washed several times before the flask is finally filled with water from a distillation outfit. The flask is blackened outside leaving circular holes for ingress and egress of light and light from a powerful carbon arc is focussed on the water. The intensity of light scattered trans-

versely is measured by comparison with that of a standard source using a Lummer-Brodhun cube and the depolarisation measurements are made by the well-known Cornu method. Measurements are made at the end of every half-hour for the first five hours and afterwards at the end of every five hours. In order to make sure that the results are not vitiated by contamination of water by the impurities of air, a test experiment was carried out with silver bits placed in the flask and distilling water into it by vacuum distillation. Results more or less identical with that given by the open distillation method, were obtained.

The effect of copper, silver and brass on water is to increase the intensity of scattering rapidly in the first five hours and afterwards slowly till a steady value is reached in about 48 hours. The results of the measurements are given in Table I. The effect due to silver is most marked, the maximum increase being

TABLE I

Intensity of Scattering: Reading for Fresh
Double-Distilled Water = 1.5

Time in hours	Water in contact with		
	Silver	Copper	Brass
0	2.103	2.146	2
$\frac{1}{2}$	2.253	2.193	2.09
1	2.397	2.253	2.10
$1\frac{1}{2}$	2.508	2.253	2.13
2	2.547	2.306	2.15
$2\frac{1}{2}$	2.644	2.350	2.20
3	2.703	2.378	2.226
$3\frac{1}{2}$	2.789	2.453	2.235
4	2.859	2.453	2.25
$4\frac{1}{2}$	2.90	..	2.30
5	2.952	2.547	2.312
6	3.032	2.605	2.35
7	3.17	2.654	2.378
24	4.077	3.356	2.88
32	4.126	3.445	2.88
48	4.24	3.534	2.88

nearly three times that of pure water. Copper comes next and brass last. It is also observed that gold does not affect the intensity appreciably. The track of scattered light is blue and homogeneous showing that the scattering particles are uniformly dispersed and in fine colloidal form.

The values of ρ_u , ρ_v and ρ_h (calculated using Krishnan's Reciprocity relation) for silver and copper samples are given in Table II.

TABLE II

Time of contact in hrs.	$\rho_u\%$		$\rho_v\%$		$\rho_h\%$	
	Silver	Copper	Silver	Copper	Silver	Copper
0	9.0	9.51	4.66	4.75	95.8	91.02
6	10.62	11.38	5.26	5.57	88.86	83.49
12	12.53	14.05	5.90	6.78	80.3	82.48
24	14.88	16.61	6.43	7.40	68.34	70.68
48	17.29	18.83	6.58	7.86	55.53	63.14
72	17.31	18.85	6.60	7.80	55.69	62.30

The finite values of ρ_v and ρ_h indicate that the scattering particles are anisotropic and not small compared with the wavelength of light. With increase of time of contact, ρ_c increases slowly, indicating a slight increase in anisotropy of the particles. ρ_h decreases at first rapidly and afterwards slowly till it reaches a minimum value. From this it may be concluded that the particle-size of the metal sol gradually gains in size.

My thanks are due to Dr. C. S. Venkateswaran, Principal, University College, for suggesting the problem and for his keen interest in the work.

Univ. College,
Trivandrum,
June 12, 1951.

MRS. ALEYAMMA GEORGE.

SCATTERING OF LIGHT IN COLLOIDAL DYE SOLUTIONS

A STUDY of the colloidal properties of the dyes is of importance as there is a close relationship between the micellar nature and the kinetics of the dyeing process. A study of the scattering of light in certain dye solutions (Chrysophenine G and Benzopurpurine 4B) has been undertaken by the author with a view to determining the state of aggregation and the anisotropy of the dye micelles in solution under different conditions.

The experimental methods used were mainly the same as those employed by R. S. Krishnan¹ except that incident white light was used. The depolarisation values and the intensity of the transversely scattered light (in terms of the microammeter reading in the photo-electric amplifier) for a particular dye and salt concentration at different temperatures are given in Tables I and II.

TABLE I

Chrysophenine G 0.066 gram/litre,
NaCl 8 grams/litre.

Temperature in °C.	$\rho_u\%$	$\rho_v\%$	$\rho_h\%$	$\Delta\rho_u\%$	Intensity
26	26	14.7	100	0	7.6
30	17	7.0	61	4	6.4
35	16	5.8	42	5	5.0
40	16	4.5	33	7.4	4.0
55-85	16	4.2	32	8.0	3.0

TABLE II

Benzopurpurine 4B 0.082 gram/litre,
NaCl 12 grams/litre

Temp-ature in °C.	$\rho_u\%$	$\rho_v\%$	$\rho_i\%$	$\Delta\rho_u$	Intensity
27	5.5	3.6	70	1.5	2.8
35	11	4.3	63	3.0	3.0
40	14	4.7	54	5.0	3.1
50	16	5.8	50	5.0	3.4
60	19	8.0	56	4.0	3.1
65	20	8.8	56	3.8	2.7

Care was taken to ensure that the salt concentration was small enough so as not to affect

the stability of the sol. $\Delta\rho_u$ has been calculated from the equation $\Delta\rho_u = \rho_u (\text{obs.}) - 2\rho_v / (1 + \rho_v)$. To a first approximation, the anisotropic part of ρ_u can be considered as equal^{2,3} $\frac{2\rho_v}{(1 + \rho_v)}$ and the difference may be taken as a measure of the finite size of the scattering particle. ρ_h , which is 100 per cent. for small anisotropic particles, reduces to zero for large isotropic particles and it is also a measure of the size of the scattering particle. Further the intensity due to pure density scattering is proportional to the absolute temperature and a decrease in the intensity of the scattered light with rise of temperature is to be attributed to a formation of clusters or large micelles.

From the experimental observations given above, it is clear that, while the micelles of Chrysophenine G at 26° C. are small and anisotropic, those of Benzopurpurine 4B are anisotropic and of size not small compared with the wavelength of light. In the case of Chrysophenine G the intensity as well as the depolarisation values show a gradual decrease followed by a sudden drop at a temperature which may be called the "transition" temperature. These facts indicate that, even at higher temperatures, larger but more spherical micelles are present and this result for Chrysophenine G is in keeping with Morton's⁴ observations based on ultrafiltration experiments. On the other hand, Benzopurpurine 4B shows a continuous increase of ρ_v and a minimum value for ρ_h at the transition temperature due to the formation of larger and more anisotropic micelles. Such a result can be expected if the micelles group end to end and grow only in one direction. Beyond the transition temperature, $\Delta\rho_u$ decreases and ρ_h increases showing thereby that the micelles are now probably going into solution. The transition temperature in the case of both the dyes is a function of the dye and salt concentrations. Further work is being continued and a detailed report will be published elsewhere.

My thanks are due to Prof. R. S. Krishnan for his help and encouragement.

Dept. of Physics, S. R. SIVARAJAN.
Indian Institute of Science,
Bangalore,
June 21, 1951.

1. Krishnan, R. S., *Proc. Ind. Acad. Sci.*, 1937, 5, 551.
2. Gans, *Ann. der Phys.*, 1912, 37, 883. 3. Bhagavantam, *Scattering of Light and the Raman Effect*, Chemical Publishing Co., 1942. 4. Morton, *Trans. Faraday Soc.*, 1935, 31, 262.

ON THE RECOGNITION OF FAULTS IN THE GRANITIC TERRAIN IN MYSORE

THE recognition of planes of dislocation in areas covered entirely by crystalline rocks is a matter of difficulty. Excepting in areas like the Kolar schist belt where exploitation of the gold quartz veins by deep mining has laid bare the structure and helped to identify and trace several faults, in all other cases in Mysore, surface observation alone has rarely suggested the existence of planes of dislocation.

During the course of our recent work tracing the boundary between the Closepet granite and the Peninsular gneiss some twenty miles west of Bangalore, we came upon a clear instance of faulting in a region covered almost entirely by different types of banded gneisses and granites. It is our object to describe the geological features of this region which has enabled us to conclude the existence of clearly recognisable fault planes.

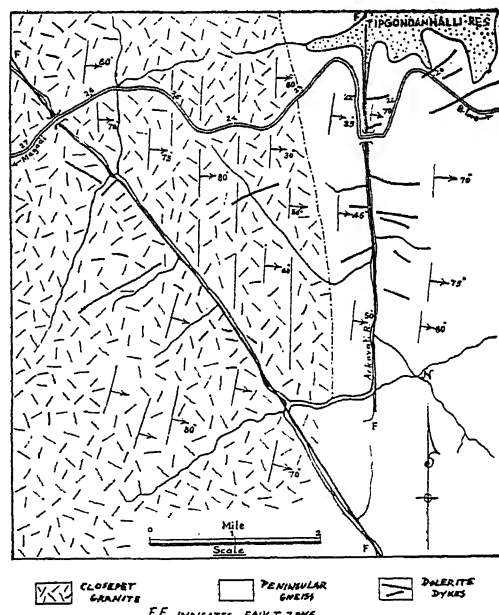


FIG. 1

A portion of the 1" sheet of the region surveyed is here reproduced to show the topographic peculiarities of the area. The one outstanding feature which strikes our attention is the remarkably straight course of the river Arkavati and its tributary stream. The straight courses of rivers over considerable distances cannot be an accidental feature. Moreover, these streams flow in narrow gorges and the conclusion is inescapable

that these narrow zones represent planes of weakness, probably fault zones.

Our attention was, therefore, concentrated on a close study of the geologic features of the region in the immediate neighbourhood of the river Arkavati and its tributary to find out whether any positive evidences of faulting were forthcoming.

The geology of the area is fairly simple. The rocks to the east of the river are mostly granitic gneisses with a strike of 10° E of North and dipping at high angles of 75° and more to the east. There are occasional bands of pink gneiss amidst the granitic gneisses. The rock types west of the river are also gneissic with a greater preponderance of the pink bands on account of the proximity to the Closepet granites. The strike of the gneisses is very nearly North-South and the dip varies from 40° to 50° E.

The river bed is the most interesting part. This is occupied by a band about 100 feet in width of a feldspar-quartz-rock, with numerous veins and veinlets of bright green epidote. The feldspar is invariably of a deep flesh red colour. This narrow belt is highly crushed and jointed. The pinkish feldspathic portions appear more like veins in the crushed zones. They occur in the form of a series of parallel veins healing up the fractures. There are frequent changes in the strike direction of these veins.

Two furlongs downstream from the waste weir of the Tipgondanahalli reservoir, evidences of faulting are still more clear. At this point, water flows in one straight line for a distance of more than 200 yards in a narrow drain about 10 feet wide. The slickensided face and the straight edge of the fault are very well exposed. The fault plane is seen to dip towards the east at an angle of 50° .

The behaviour of the dolerite dykes on either side of the fault line provides further confirmatory evidence of faulting. Several dykes of dolerite are seen crossing the region in a roughly east-west direction. The dykes are seen to terminate abruptly at the junction with the fault plane. The continuation of these dykes on the other side of the fault is not traceable.

These evidences were again verified in the case of the tributary stream which crosses the Magadi road near the 5/27 milestone. This stream too, as can be seen from the map, has a straight course for nearly 9 miles. The only difference in this case is that the line of river flow is oblique to the strike direction of the rocks. Outcrops of rock are not numerous in the stream bed, but where present they show the deep flesh-red feldspathic rock with veins of green epidote. The phenocrysts in the ad-

joining gneiss too are seen to have turned a deep red colour.

The straight courses of streams and streamlets for considerable distances, the presence of peculiar and characteristic type of fault rock made up of flesh-red feldspar and bright green epidote, the abrupt stoppage of dykes at contact with these planes of dislocation are indicative of the existence of fault planes. Taken singly or together, these features serve to distinguish fault zones in areas covered by granitic rocks where identification of such structures is by no means easy.

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July 6, 1951.

ON A SAMPLE OF "PLAGIOCLASE-GRANULITE" (ANORTHOSITE) ASSOCIATED WITH CALC-GRANULITES IN NORTH MANBHUM

THE occurrence, in North Manbhumi, of a granulitic rock identical to anorthosite in composition, and hence an anorthosite for all purposes, is being reported here for the first time. The credit of its discovery goes to the junior author.

The rock occurs in close association with typical calc-granulites and amphibolites ($86^{\circ}42'30''$ E; $23^{\circ}31'$ N approximately), all showing gradual lateral passage (cf. also¹ and²); and consists of acid bytownite, or rather labradorite-bytownite ($2V_x = 85^{\circ}$) as the chief constituent with accessory hornblende, epidote-zoisite and calcite. There are alternating hornblende-rich (amphibolite) bands occurring in thin streaks, similar to those seen in the calc-silicate granulites from Pahargora.¹

The rock is genetically connected with calc-granulites, and assemblages show a passage from one type to the other by a change in the relative proportion of the constituent minerals. This variation, characteristic of these rocks, has been ascribed to an original difference in composition of the sediments. The related assemblages with various combinations and varying proportions of plagioclase, diopside, calcite, tremolite and hornblende are characteristic of the paragenesis of cordierite-anthophyllite subfacies of the amphibolite facies.

Another fact worthy of mention is the association of kaolin with these rocks (Dhatarā), a feature also noticed by Chatterjee in case of the white anorthosites of Bankura³.

The rock is not being described as an anorthosite straight off on account of its very distinctive, but easily readable, genetic

features. But it shows, nonetheless, all characters essentially those of typical anorthosites, such as are met with in rocks described from Raniganj.² Indeed the two could not be told apart either in hand specimens or from their mineralogical and textural characters. It seems possible, thus, that anorthosites and anorthosite assemblages could very well be produced by high grade metamorphism of calcareous sediments having sufficient aluminous impurities and very little or no magnesia.

We appreciate fully the very serious import of the implication, but in view of the unequivocal field relations, we wish to draw attention of petrologists working in related fields, to such a possibility.

SAURINDRANATH SEN.

Calcutta University,
March 3, 1951.

BIMALENDU ROY

CHOWDHURY.

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Chatterjee, S., *Anorthosite of Bengal*.

ISOLATION OF NEW NIOBATES

THE niobates of the alkali,^{1,2} alkaline earth and a few other metals³⁻⁴ have been prepared. However literature does not record the existence of the niobates of lead, tin and some heavy metals. Recently a new niobate of lithium and a tartratonibate of lead were reported.⁵⁻⁶ Hence studies on niobates were undertaken and two new niobates (of lead and tin) have been isolated.

The general method of preparation of the niobates consisted in reacting, under suitable conditions, a soluble salt of the metal with sodium niobate. Sodium niobate $\text{Na}_2\text{O} \cdot \text{Nb}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$ was prepared from very pure materials by the method of Balke and Smith.⁷ To a hot clear solution of sodium niobate, a hot 10% solution of lead nitrate or acetate was added in a thin stream with rapid stirring, when a dense white curdy precipitate was formed. It was filtered, washed thoroughly and dried. The compound was analysed for lead and niobium by a method which was evolved. It has been found to occur in two hydrates having the following percentage compositions:

- I. $\text{PbO}-39.40$, $\text{Nb}_2\text{O}_5-44.09$, $\text{H}_2\text{O}-16.51$;
II. $\text{PbO}-34.31$, $\text{Nb}_2\text{O}_5-39.95$, $\text{H}_2\text{O}-25.74$.
The results agree closely with calculated values and therefore the new lead niobate isolated has the formula $\text{PbO} \cdot \text{Nb}_2\text{O}_5 \cdot n\text{H}_2\text{O}$ (where $n = 5$ or 10). Lead niobate is a white insoluble powder. Dehydration studies on the two hydrates have

been conducted and it has been found that there is a loss of nearly three molecules of water by keeping at 110°C . for about 5 hours.

The preparation of the anhydrous lead niobate has been attempted by the fusion of equimolecular proportions of lead carbonate and niobium pentoxide.

A niobate of tin has been prepared by the reaction of stannous chloride with sodium niobate. It is worth recording that on the addition of stannous chloride, a white precipitate is formed which immediately changes colour to yellow. The compound has been analysed and found to have the percentage composition,

$\text{SnO}_2-37.57$, $\text{Nb}_2\text{O}_5-48.26$, $\text{H}_2\text{O}-14.07$. It is interesting that in the case of tin, a niobate ($4\text{SnO}_2 \cdot 3\text{Nb}_2\text{O}_5 \cdot 13\text{H}_2\text{O}$), with a base to acid ratio of 4 : 3 is formed, which is usually encountered in the alkali metals.

A bismuth niobate has just been prepared and full details will be published elsewhere.

We have pleasure in thanking Prof. Brahm Prakash for his kind interest in the work.

Dept. of Metallurgy, N. R. SRINIVASAN,
Indian Institute of Science, K. VENUGOPALAN,
Bangalore 3,
June 25, 1951.

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AN IMPROVED METHOD FOR THE CYCLIZATION OF ARYL ω -DI- METHOXYETHYL SULPHIDES

A NEW synthesis of thionaphthene, which has been extended to substituted thionaphthenes and to other thiophenes and thiapyrans, consisting of the cyclization of phenyl ω -dimethoxyethyl sulphide (I) by treatment with phosphorus pentoxide-phosphoric acid mixture in an optimum yield of 37% has been described recently by us.¹ The yield was, however, only 37%. Attempts to effect ring-closure of (I) by treatment with fused sodium acetate and acetic anhydride, fused zinc chloride and glycerine, glacial acetic acid or acetic anhydride anhydrous oxalic acid and pyridine hydrochloride at temperatures varying, from room temperature to 160° were unsuccessful. Attempts at the cyclization of (I) by means of phosphorus pentoxide-phosphoric acid mixture at 0° , room temperature ($27-29^\circ$) and at 60°

led to an oil which gave a dinitrophenylhydrazone of *S*-phenylthioglycolic-aldehyde but not thionaphthene picrate. The yield of thionaphthene from (I) was finally improved from 37 to 72.5 per cent by carrying out the cyclization as follows:— A mixture of phosphorus pentoxide (34 g.) and phosphoric acid (21 c.c.) was heated to 170–80° in vacuum (10 mm.) and (I) (8.5 g.) was then added to the separating funnel from which it was led to the acid mixture during 30 minutes. The residual sulphide was rinsed with a little benzene. Thionaphthene, which formed the distillate, was collected in an ice-cooled receiver which was connected to vacuum through an ice-cooled trap. The crude thionaphthene (5.10 g., yield 89%) did not give a dinitrophenylhydrazone, but readily formed the picrate. It was distilled twice under reduced pressure and finally steam-distilled when the yield dropped to 72.5%. The purified thionaphthene melted at 26.5–27.5°.

Cyclization of *m*-tolyl ω -dimethoxyethyl sulphide (7 g.) by treatment with phosphorus pentoxide (28 g.)–phosphoric acid (17 c.c.) mixture at 160–70°/10 mm. under the above conditions gave a 95% yield (4.65 g.) of crude 6-methylthionaphthene, the yield after steam distillation was 78% (3.83 g.). Similarly, *o*-bromophenyl ω -dimethoxyethyl sulphide (3 g.), on treatment with phosphorous pentoxide (12 g.)–phosphoric acid (15 c.c.) at 170–80°/10 mm., gave the hitherto unreported 7-bromothionaphthene (1.64 g., yield 72%), b. p. 107–09°/10 mm. (picrate, m. p. 144–45°).

Dept. of Chem. Technology, K. RABINDRAN.
University of Bombay, B. D. TILAK.
April 10, 1951.

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THE FLUORESCENCE TEST AS APPLIED TO CARBOXYLIC ACIDS

THE fluorescence test is usually carried out by heating together small quantities of resorcinol and phthalic or succinic acid (or their anhydride) in presence of a few drops of conc. H_2SO_4 , pouring it in water, which on making alkaline to NaOH gives a green orange fluorescence. The test is recommended in several text books¹ for the detection of the above acids and their anhydrides. Perkin and Kipping² mention its applicability for the detection of inner anhydrides while Bernthsen and Sudborough³ record that benzoic acid also gives this test.

We have observed that aliphatic monobasic acids (e.g. formic to butyric, oleic, palmitic, stearic, monochloroacetic and lactic), aromatic monobasic acids (e.g. *o*- and *m*-toluic, *m*-hydroxybenzoic, gallic, cinnamic, salicylic and hippuric), and others, such as nicotinic and uric acids also give the test similar to that of phthalic and succinic acids, showing that the test cannot be taken as characteristic of the latter only.

The final alkaline solutions retain their green-orange fluorescence even on prolonged exposure to air; only in some cases (e.g. acetic, monochloro-acetic and lactic) it changes to a violet fluorescence.

The blue fluorescence of malic and citric acids, when subjected to this test, may be ascribed to the formation of 7-hydroxy coumarin derivatives which are known to fluoresce in this manner in alkaline media. All the experiments were performed using conc. H_2SO_4 (A.R. quality), pure resorcinol (of Rhodia, medicinal quality) and the purest available organic acids and the reproducibility of every test has been ascertained.

The green-orange fluorescence may be due to compounds formed by the condensation of resorcinol with the organic acid in presence of conc. H_2SO_4 . Although no systematic work appears to have been done in this direction, some workers^{4,8} have condensed resorcinol with certain carboxylic acids in presence of anhydrous zinc chloride. Only in a few cases the green orange fluorescence of the products of condensation has been reported.

Beilstein records that on heating resorcinol in a sealed tube, or along with anhydrous ZnCl_2 , HCl, or conc. H_2SO_4 , some compounds are formed which fluoresce in alkaline media. We have found that resorcinol does so with conc. H_2SO_4 only under very particular conditions which are different from those usually employed for the reaction between resorcinol, carboxylic acids and conc. H_2SO_4 . A green-orange fluorescence is obtained when 0.5 g. of resorcinol and 0.2 c.c. of conc. H_2SO_4 are heated in a test-tube for one minute in a bath at 170°; the resulting dark red liquid is allowed to cool, mixed with about 50 c. c. of water and a few c.c. of NaOH are added to render it alkaline. Any deviation from these conditions gives faintly fluorescing or a mere orange coloured solution. The fluorescence of the alkali solution, however, disappears completely on exposure to air for a few hours.

Further work is in progress particularly with a view to determine the nature of the fluore-

scent products obtained with typical carboxylic acids as also with some sulphonic and arsonic acids.

Chemical Laboratories, L. N. MULAY.
The Institute of Science, R. M. MATHUR.
Bombay,
March 28, 1951.

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A NEW SYNTHESIS OF DIBENZO-THIOPHENE

DIBENZOTHIOPHENE (I) occurs in coal-tar together with crude phenanthrene and is used as a dyestuff intermediate and also in the synthesis of physiologically active compounds. Several syntheses of (I) have been reported. The new method, which has now been developed for the preparation of (I), is similar to the synthesis of 2- and 2:3-dimethylbenzo- and naphthothiophenes described recently by Werner.¹

Condensation of thiophenol with 2-bromocyclohexanone in presence of alcoholic sodium ethoxide in boiling water-bath gave 2-phenylmercaptocyclohexanone (II). It gave colourless oil on distillation, b.p. 152-3° (bath temp.)/10 mm. (yield, 77%) (Found: C, 69.7; H, 6.5. $C_{12}H_{14}OS$ requires C, 69.9; H, 6.8%). 2:4-Dinitrophenylhydrazone from (II) crystallized from alcohol-ethyl acetate in yellow needles, m.p. 162-3° (Found: C, 56.6; H, 5.1; N, 14.1. $C_{18}H_{18}N_4O_4S$ requires C, 56.0; H, 4.7; N, 14.5%).

Treatment of (II) with phosphorus pentoxide at 170-80° yielded 1:2:3:4-tetrahydrodibenzothiophene (III), which gave a colourless oil on distillation, b.p. 141° (bath temp.)/10 mm. (yield, 74%) (Found: C, 76.6; H, 6.5. Calc. for $C_{12}H_{12}S$: C, 76.6; H, 6.4%). The compound has been reported earlier being prepared by the Clemmensen reduction of 1-keto-1:2:3:4-tetrahydrodibenzothiophene.² The picrate

from (III) crystallized from absolute alcohol in orange needles, m.p. 108-9° (Found: N, 9.6. $C_{18}H_{15}N_3O_7S$ requires N, 10.1%).

Dehydrogenation of (III) by selenium² at 300° for 22 hours gave a 91% yield of dibenzothiophene, m.p. 96-8°. After recrystallization from alcohol, it gave elongated colourless needles, m.p. 98° (*cf. Literature*^{3,2} m.p.'s 99° and 95-6°) (Found: C, 77.8. H, 4.5. Calc. for $C_{12}H_8S$: C, 78.3; H, 4.4%). The picrate from (I) gave fine yellow needles, m.p. 123-4° from absolute alcohol; Gilman and Jacoby³ give m.p. 125° (Found: N, 10.3. Calc. for $C_{15}H_{11}N_3O_7S$: N, 10.2%).

A few 4-substituted derivatives of (I) have been prepared through metalation² and 2- and 2:8-disubstituted derivatives are obtainable by direct substitution.^{3,4} With the exception of these compounds, other derivatives of (I) are not readily accessible. Starting from arylthiols and substituted 2-bromocyclohexanones, new substituted derivatives of (I) as well as its higher polycyclic derivatives may now be synthesized by the above method. Similarly by using bromotetraones in place of 2-bromocyclohexanone, other sulphur-containing polycyclic ring systems could also be built up. Work on these lines is in progress.

Dept. of Chem. Technology, K. RABINDRAN.
University of Bombay, B. D. TILAK.
Matunga Road, Bombay 19,
May 8, 1951.

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CHEMICAL INVESTIGATION OF THE GUM FROM DRUM-STICK PLANT MORINGA PTEROSPERMUM

ROUTINE analysis of the purified gum indicated the following composition:— Ash 0.3%; pentoses 50.2%; methyl-pentoses 0.5%; cellulose 5.3%; hexo-uronic acid 11.9% and galactose (by difference, as the yield of mucic acid was low) 31.8%.

After hydrolysis of the gum by 3% sulphuric acid the reducing sugars were removed by alcohol, and the barium salt of uronic acid was isolated in a pure condition. This barium salt on oxidation with nitric acid, gave mucic acid and saccharic acid. The

further hydrolysis of the salt gave galactose m.p. 162°C , $\alpha = +78.5$. The barium percentage in the salt indicated that the acid might be composed of two galactose and one glucuronic acid units. The structure of this acid is being worked out.

Examination of the sugars produced by the hydrolysis of the gum on the paper chromatogram indicated the presence of galactose, arabinose and a methyl-pentose. The Rf value of the methyl-pentose agreed very well with that of rhamnose. The chromatogram was developed by the modified procedure of Trevelyan, Procter and Harrison.¹ It was found that the same procedure could be used for identifying polyhydric alcohols like mannitol.

Maharaja Pratapsigh
Chem. Laboratory,
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Poona 2,
June 10, 1951.

T. R. INGLE.
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1. Trevelyan, Procter and Harrison, *Nature*, 1950, 166, 444.

OCCURRENCE OF THE GENUS *ATYA* LEACH (CRUSTACEA: DECAPODA: ATYIDAE) IN THE INDIAN MAINLAND*

So far only two genera of the primitive family Atyidae have been known from the Indian mainland. Of these two, *Caridina* is very extensively distributed in Indian waters and is represented by a number of species, while the other genus has got only one Indian species *Paratya curvirostris* (Heller) recorded by Kemp^{1,2} from Tezpur (Darrang District) and Manipur Hills in Assam. There is, as yet, no record of the occurrence of *Atya* from India, although Kemp referred to "a few specimens from the Andamans" and "a single specimen from Ceylon" as belonging to this genus. Kemp had, however, not given specific identity of these specimens. In addition Roux³ has recorded *Atya moluccensis* de Haan from Burma and Ceylon and he also considered Kemp's Andamanese and Ceylonese specimens as perhaps belonging to this species.

Recently, Mr. A. G. K. Menon has brought a small collection of freshwater decapod crustaceans from Koraput Hills, Orissa, which contains three good specimens of the genus *Atya*. On examination these proved to belong to *Atya moluccensis*. Kemp's Andamanese specimens, also were found to belong to the above-named species. The Indian and the Andamanese examples, however, differ in some respects from the typical Malayan form, A

detailed report on these, along with other material of *Atya* preserved in the collections of the Zoological Survey, will be published at a later date.

The discovery of *Atya moluccensis* in the Indian region extends the range of this species further westwards and furnishes yet another evidence of the close affinity between Indian and Malayan faunas.

Zoological Survey of India, K. K. TIWARI.
34, Chittaranjan Avenue,
Calcutta 12,
April 20, 1951.

* Published with the permission of the Director, Zoological Survey of India, Calcutta.

1. Kemp, S., *Rec. Ind. Mus.*, 1917, 13, 303. 2. —, *Ibid.*, 1912, 7, 114. 3. Roux, J., *Noe. Caledonia*, 1925, 4, 218.

LEAD ANAEMIA OF THE RABBIT AS A TEST FOR THE POTENCY OF LIVER EXTRACTS

N. GERLICH¹ reported a method for the determination of the anti-anæmic potency of liver extracts. The method determines the amount of liver extract necessary to prevent a drop in R.B.C.s and Hb, which invariably follows intravenous injection of 3 daily doses of lead-acetate (5.5-6 mg. per kg. body weight) in rabbits of 2.5 kg. weight. The author reports that liver extracts inactivated by autoclaving were ineffective.

The question was therefore examined whether or not vitamin B₁₂ counteracts Gerlich's lead-anæmia, because factors other than B₁₂ may detoxify and be inactivated by autoclaving.

Three rabbits of 1.5 kg. all from the same parents, made anæmic with identical doses of lead acetate (Haffkine Institute strain) received therefore 3 µg, 6 µg, and 9 µg, B₁₂ each. From Table I it may be seen that increased doses result in an increased R.B.C. count.

TABLE I

Single Dose B ₁₂ by vein	Rabbit No.	Increase in R.B.C.s in millions			
		3rd day	5th day	7th day	9th day
3 µg	3	1.0	1.5	1.6	1.2
6 µg	5	1.3	1.7	2.0	1.6
9 µg	2	1.6	2.0	2.6	2.3

The R.B.C. counts were all near 3 millions before administration of B₁₂. It appears thus

that not only the protecting influence of various doses of liver extracts, but also the direct increase in R.B.C.s can be used, if the maximal increase, which in our animals occurred on the 7th day, is determined. Further work is in progress.

We thank Mr. W.T. Suren and Dr. B.K. Nandi, Chief Chemist and Manager of Messrs. Teddington Chemical Factory Ltd., for their kind permission to carry out this work.

Research Department,
Teddington Chem. Factory Ltd.

Andheri, Bombay, F. W. VAN KLAVEREN.
June 25, 1951. P. C. SHRIVASTAVA.

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PHOTOPERIODIC RESPONSE IN SOME EARLY VARIETIES OF PADDY

DIFFERENT varieties or strains of paddy in the various localities of India have been reported to show marked contrast in their day-length requirement.¹⁻⁷ In the present communication the photoperiodic response in four early varieties of paddy grown in U.P. is reported. Pure seeds of the four early varieties, T. 136, T.N. 22 (*Rajbhog*), T.N. 27 (*Banki*), and Ch. 10 (*Tandwa White*) after being sterilized in 0.2% formalin solution were sown in earthenware pots, 11" x 10", filled with a mixture of well pulverised garden loamy soil and cow dung manure in the proportion of 8:1. Eighteen days after sowing, the 10-hour short-day (8 A.M. to 6 P.M.) and the 24-hour long-day (extra light supplied from a 1,000 watt 'Osram' gas-filled bulb) treatments were begun. Five treatments including the control with 6 pots in each were employed; in all there were 120 pots in this investigation. Each pot had 4 plants. The results are presented in Table I.

A study of the results in Table I shows that the application of short photoperiods of 10 hours induces a significant delaying effect in both the experimental sets. The degree of delaying effect is dependent on the duration of the treatment, maximum delay being observed by continuing the treatment till the time of ear emergence. An exposure of seedlings for 30 days induces a delaying effect of 5-9 days depending on the particular variety used, whereas delay of earing was 8-15 days when the treatment was continued until heading. In the light of these findings, Kar's statement² that in different varieties of paddy warm temperature associated with short day-length is inductive to earliness and cold temperature or longer day-lengths produce retardation, needs modification. In these four early varieties of paddy grown throughout their life period under the naturally prevailing high temperature, short days did not induce earliness but rather they have greatly prolonged the time of ear emergence.

The other interesting result of this investigation is that in the experimental set where the short days were prolonged until heading it was noted that in about 50% of the total plants in varieties T. 136 and T. N. 22, in 41.6% of the plants of variety T.N. 27 and in 21% of the plants in variety Ch. 10, the ears of the main shoot did not come out of the boot. On dissection of the culms in these cases it was observed that although the ears were formed, their growth was arrested inside the boot. Thus the effect of the prolonged short-day treatment may be resolved into two groups (a) delay in the ear emergence and (b) total suppression of the emergence of ear of the main shoot. The suppression of the emergence of ear of the main shoot in a certain percentage of the plants and not in the entire population was possibly due to the fact that these plants

TABLE I

Showing the days from sowing to first panicle emergence. Sowing date May 7, 1949; Treatment begun May 25, 1949. + indicates induced earliness.— indicates induced delaying effect.

Treatments	(Average time in days from sowing to ear emergence)				Difference from control in days			
	T. 136	T.N. 22	T.N. 27	Ch. 10	T. 136	T.N. 22	T.N. 27	Ch. 10
A. Control	90.68	88.30	87.18	90.43	..	..	..	..
B. Short-day treatment for 30 days	97.13	96.60	94.96	95.61	-6.45	-8.30	-7.78	-5.18
C. Short-day treatment prolonged till ear emergence	98.95	102.87	100.50	102.00	-8.27	-14.57	-13.32	-11.57
D. Long-day treatment for 20 days	91.08	90.26	..	..	-0.40	-1.96	..	..
E. Long-day treatment for 30 days	93.11	90.61	..	..	-2.43	-2.31	..	..

might not have reached the same developmental stage as the others to react to the photoperiodic stimulus in a similar manner. Detailed histological and micro-chemical tests of the culms below the arrested spikelets might throw more light as to why the stem elongation was inhibited in those cases. One of the possible reasons for this irregularity might be assigned to the fact that although the entire stock of the grains used in this experiment were pure varieties, it might be a mixture of a number of physiologically different strains so far as their reactions towards the prolonged short-day photoperiod are concerned. From the results of this experiment and of the previous workers it appears that the response of paddy varieties to photoperiodic treatment is of varietal character.

Grateful thanks are due to Prof. Shri Ranjan for his useful suggestions and guidance and the facilities provided by him in the Botanical Laboratory of the Allahabad University for carrying out this piece of investigation.

Department of Botany, GADADHAR MISRA.
Ravenshaw College,
Cuttack 3,
February 28, 1951.

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ON A NEW SPECIES OF NYCTOTHERUS FOUND IN UPERODON SYSTEMA SCHNEIDER MICROHYLIDÆ

THE only ciliate so far reported from *Cacopus systoma* (Schn.)¹ is *O. japonica* Sugiyama, which Metcalf observed in two frogs of Microhylid genus from Madras.¹

In the present note a new species of *Nyctotherus* found in one of the four adults (each measured 40 cm. from snout to vent) of *Cacopus systoma* (Schn.), from Dharwar, is described. Also, a record is made of ciliates such as *Balantidium helenæ* Bez., *Nyctotherus cordiformis* Stein., and *Opalina obtrigonoidea* lata Nie., found associated in the rectum with the new species for the first time.

The characteristic features of the new species, named as *N. cacopusi*, are: (1) the club-shaped macronucleus, (2) the cytostome placed towards the anterior pole of the body, (3) the straight but obliquely placed cytopharynx,

and (4) the angular position of both the macronucleus and the cytophyge.

The smears were fixed with Bouin's fluid and stained with Delafield's Hematoxylin. All the figures have been drawn with the aid of a camera lucida.

Nyctotherus cacopusi nov. sp.

Measurements in microns.—Body (length \times breadth) 465×350 ; macronucleus (length \times breadth) 170×55 ; micronucleus, oval (length \times breadth) 30×20 ; nuclear angle 65° ; shortest distance between the anterior pole of the body and the macronucleus 80 ; breadth of cytostome 35 ; anal angle 60° .

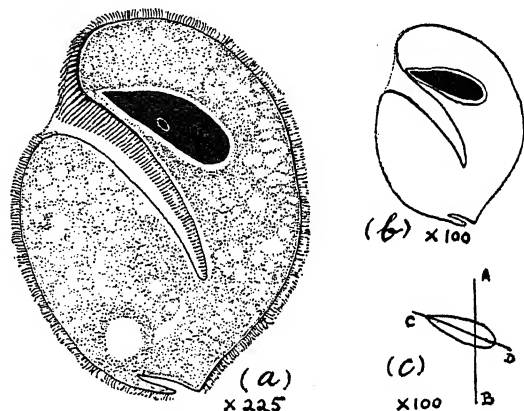


FIG. 1. (a) *Nyctotherus cacopusi* nov. sp., from *Cacopus systoma* (Schneider).

(b) The same under the low power of microscope.

(c) Shows the angle made by the macronucleus to the principal axis of the body.

The line AB represents the principal axis and CD is the line joining the anterior and posterior poles of the macronucleus.

Morphology: Body of organism bean-shaped. The two body poles, namely, the anterior and the posterior, appear somewhat narrow and bluntly rounded. The cytopharynx opening near the anterior pole extends downwards into the cytoplasm in the form of a narrow straight tube somewhat obliquely placed; and ends more or less in the middle of the posterior-dorsal portion of the body. The large club-shaped macronucleus situated immediately over the cytopharynx is characteristic. Its narrow and pointed club-end, facing the ventral side of the body is nearly touching the cytopharynx, while its opposite posterior end is broad and bluntly rounded. A noticeable feature in this *Nyctotherus* is the large, oval and distinct micronucleus usually found in the mid-ventral region of the macronucleus. Food vacuoles and

	<i>N. magnus</i>	<i>N. vorax</i>	<i>N. cochlearis</i>	<i>N. cacopusi</i> n. sp.
Body shape and size	.. Kidney-shaped 660 length	Globular 450 × 250	Shell-like 430 × 335	Bean-shaped 465 × 350
Nucleus	.. Flat and irregular	Ovoidal 100 × 75	elliptical 235 × 49	Club-shaped 170 × 55
Cytopharynx	.. Recurved at end	Circular	Circular	Obliquely straight
Nuclear angle	.. ..	65°	48°	65°
Anal angle	.. ..	..	63°	60°

granules were found distributed in the cytoplasm both in the anterior and posterior portions. A thin ectoplasm below the pellicle appeared more granulated than the endoplasm. Close to the periphery of the postero-ventral side of the body an excretory vacuole was usually present. The cytophyge is found at the posterior pole of the body. The cilia over the body are small and fine. Those on the cytopharynx are specially long and thick.

The above table shows how the four giant species of *Nyctotherus* differ from one another:—

The revised list of ciliates so far known from *Cacopus systoma* (Schneider) is as follows:—

1. *Opalina japonica* Sugiyama.,
2. *Opalina obtrigonoidea* lata Nie.,
3. *Nyctotherus cacopusi* nov. sp. mihi.,
4. *N. cordiformis* Stein.,
5. *Balantidium helenæ* Bez.

Department of Zoology,
Karnatak College,
Dharwar,
May 3, 1951.

J. C. UTTANGI.

1. Metcalf, M. M., *Proc. U.S. Nat. Mus.*, 1940, **87**, 465-64.
2. Uttangi, J. C., *Curr. Sci.*, 1948, **17**, 325-26.

INDIA INK AS A SEMEN STAIN

IN an effort to find a suitable substitute for Opal blue (Bresslau) as a semen stain, a large number of stains in various formulas were tried with little success. Two brands of India ink were found to be satisfactory—Higgins brand, an American make and Reeves brand, a British make. The semen of a large number of farm animals including the bull, buffalo, ram, buck, boar, stallion, jack and the rooster, was used in this study. The technique of staining consists of rapidly and thoroughly mixing a drop of semen and a drop of India ink together for a few seconds and making smears from this semen-stain mixture. The entire staining process is completed in a few seconds and smears are ready for examination in less than one-half minute. The smears should be neither too thick nor too thin, a

properly made smear presenting a deep brown to a blackish brown appearance to the naked eye. In such preparations the India ink supplies the dark background against which the unstained sperm appear as whitish structures. This is an excellent method for demonstrating the cytoplasmic drops which, when present, appear as shining white globules. The several morphological features of spermatozoa are clearly brought out to enable a gross morphological study. Since opal blue is not available in this country at present, India ink can be used instead in artificial insemination work for the study of sperm morphology.

There is not much to choose between the two brands of India ink used in this investigation. Smears made by this technique remain in excellent condition without fading for a period of three years in the author's experience and probably much longer. No special precautions are necessary for the storage of India ink.

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Madras Veterinary College, C. KRISHNA RAO.
Vepery, Madras.
May 25, 1951.

CHROMOSOME NUMBERS OF SOME WILD CUCURBITS

THE members of the genus *Melothria* have a wide distribution and are known to occur in South America, S. Africa, Australia and Asia. They occur wild and do not belong to the cultivated group of cucurbits. The genus comprises 69 species of which chromosome numbers of three species,¹ namely *Melothria Japonica* $2n = 22$, *M. punctata* (*abyssinica*) $2n = 24$ and *M. scabra* $2n = 24$ have been reported. Some species of this genus occur in India of which four species, viz. *M. maderaspatana*, *M. leiosperma*, *M. perpusilla*, and *M. heterophylla* are found in the Bombay State. The chromosome numbers for these four species have been determined and are reported here.

Darlington and Janakiammal¹ give the basic number (x) of this genus as 11 and 12. *M. japonica* with $2n = 22$ belongs to the group

Name	<i>n</i>	<i>2n</i>	Sex type	Ploidy	Chromosome numbers determined by
1 <i>Helicosthia japonica</i> Maxim	11	22	Monœcious	Di-ploid	Nakajima
2 <i>M. scabra</i> Naud.	12	24	Diœcious	do	Kozhuchow
3 <i>M. maderaspatana</i> Cogniaux	11 or 11+1-2 fragment	22 or 22+1-2 fragment	Monœcious	do	Kumar and Vishweshwara
4 <i>M. liosperma</i> Cogniaux	12	24	do	do	do
5 <i>M. heterophylla</i> Cogniaux	24	48	Diœcious	Tetraploid	do
6 <i>M. punctata</i> (<i>abyssinica</i>) Cogniaux	12	24	do	Di-ploid	McKay
7 <i>M. perpusilla</i> Cogniaux	24	48	Monœcious	Tetra-ploid	Kumar and Vishweshwara

with 11 as basic number and *M. punctata* and *M. scabra* belong to the second group with 12 as basic number. Among the species represented in the Bombay State, types belonging to both the basic numbers are observed as shown in the table given above.

From a cytological study of the species occurring in the Western Ghats of the Bombay State, it is observed that there is a polyploid series within the genus. Of the species so far reported they belong either to the diploid with $2n = 22$ or 24 and tetraploid with $2n = 48$. Further studies on the interrelationships of the species occurring in the Western Ghats are in progress and will be reported elsewhere.

Cytological Laboratory, L. S. S. KUMAR.
College of Agriculture, S. VISHVESHWARA.
Poona 5,
May 30, 1951.

1. Darlington and Janakiammal, *Chromosome Atlas of Cultivated Plants*, 1945.

GENUS *HELICOCERAS* LINDER, NEWLY REPORTED FROM INDIA

THIS fungus was isolated from dead wood of *Cassia sumatrana* Roxb. Small wood pieces from the shoot of a dead tree were externally sterilised with conc. borax and 0.1% mercuric chloride solutions and kept in sterilised moist chamber. After about a week the pieces which had developed a small violet mycelium on them were transferred to standard synthetic agar slants where a copious dark mycelium developed within three days.

The fungus grew well in culture medium and presented a dark appearance but the cultures could not survive in winter. Examination of the mycelium reveals that it is a typically dematiaceous fungus with long, slender and coiled conidia characteristic of helicosporous *Fungi Imperfecti*. The hyphæ are dusty hyaline about 3.5μ thick, irregularly branched and septate—

septa being about $15-20\mu$ apart. Conidia are more or less in bunches each conidium being dusty hyaline and coiled. They are slender, about 6.7μ wide but their total length and other characters, viz., number of septa, number of times the conidium is coiled, varied. The majority are $60-70\mu$ long and have $1\frac{1}{2}$ coils and 10-13 septa.



FIGS. 1, 2. Photomicrographs of *Helicoceras oryzae* showing conidia, $\times 275$.

The characters show that it is a member of helicosporous *Fungi Imperfecti*. The fungus slides were sent to the Commonwealth Mycological Institute, Kew, and it has been identified as *Helicoceras oryzae* Linder and Tullis which has been recorded by Tullis¹ from Chinese rice in U.S.A.

This appears to be the first record of the genus *Helicoceras* Linder which Linder² created in 1931 and also the first record of a member of helicosporous *Fungi Imperfecti* from India.

Thanks are due to Mr. S. J. Hughes of the Commonwealth Mycological Institute, Kew, for the specific identification of the fungus.

Botany Dept., DAYA NAND PANT.
Lucknow University,
Lucknow,
May 30, 1951.

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ABNORMAL SPIKE OF *HELMINTHOS-TACHYS ZEYLANICA* L.

Helminthostachys zeylanica L. is found plentiful in Burma, Assam and Ceylon. Normally the barren segment is palmately pinnate and there are three principal divisions. Each division has two pinnæ and rarely one of the lateral divisions bears three pinnæ. The fertile spike is solitary and unbranched.

A specimen collected in the Buxa Dûars of North Bengal however showed some peculiarities in the barren segment and also in the spike.

The barren segment has three principal divisions. One of the lateral divisions bears three pinnæ and the central division instead of having two pinnæ, has five pinnæ. The rachis gives off a second pair of lateral branches and finally ends in a terminal pinna.

Normally when the rachis branches it does so dichotomously and one of these branches again bifurcates resulting in three pinnæ. This is the condition in one of the lateral divisions, whereas the central division has its rachis bearing lateral branches.

The fertile spike, which is normally unbranched, is forked in the specimen. The forking takes place from the middle of the spike. Bower¹ refers that the spike of *Helminthostachys* is often subjected to accessory branchings, and according to him the branching may be combined with correlative vegetative growth where sporangia are absent. But, in the specimen under consideration, the branching of the spike and the branching of the rachis of the barren segment run parallel. The sporangia are quite normal with spores in them.

In specimens where only one of the lateral divisions bears three pinnæ the spike is unbranched and shows no indication whatsoever of branching.

The author expresses his gratitude to Dr. T. S. Mahabale for scrutinizing the manuscript and his valuable suggestions thereon.

Botany Department,
Meerut College,
Meerut,
June 4, 1951.

M. BANERJI.

1. Bower, F. O., *The Ferns (Filicales)* Camb. Bot. Handbook, 1926, 2.

NOMENCLATURE OF BACTERIAL PLANT PATHOGENS

EVER since the discovery by Burrill in 1878, that the bacteria can cause plant diseases, there has never been concord amongst the phyto-

pathogenic bacteriologists on the nomenclature of this important group. Although the workers in this field suggested several generic names, the following are now mentioned in Bergey's Manual¹: *Xanthomonas*, *Agrobacterium*, *Erwinia*, *Pectobacterium*, *Corynebacterium*, *Pseudomonas* and *Bacterium*. Of these, the first 4 are exclusively assigned to phytopathogenic bacteria. The genus *Corynebacterium* as recommended by Dowson to replace *Aplanobacter* of Smith should be rejected since the latter name was specially suggested by him for the non-motile, gram-positive plant pathogens. The genus *Pseudomonas* includes organisms in pus, soil, water, etc., and should, therefore, not be used for the plant pathogens. This genus has recently been split up into 2², viz., *Pseudomonas* and *Phytobacterium*, the latter to include non-green fluorescent phytopathogenic organisms. Dowson includes *Agrobacterium*, *Erwinia* and *Pectobacterium* under *Bacterium*, a heterogeneous group and therefore should be rejected. The writers suggest that a new family called PHYTOBACTERIACEAE be erected to include only the phytopathogenic bacteria and the following genera based on the types of symptoms produced, thus lessening confusion. This system is a natural one since it facilitates quick diagnosis and brings generally to the mind the types of symptoms each genus produces besides showing relationship at a glance, and thus proving the change more convenient and useful. The description of the new family and the new genus together with 6 other accepted genera and the typical symptoms produced by each are given below:—

PHYTOBACTERIACEAE NOV. FAM.

Organisms yellow, white, green-fluorescent or variant; short or long rods; motile with monoloph or peritrichiate flagella or non-motile; mostly gram-negative; a small number gram-positive. No endospores. Capsulated or otherwise; not acid-fast; not attacking cellulose; indol production nil or slight; aerobic; dextrose fermented with or without gas. Optimum temperature for growth 20-30° C., max. 37° C. with thermal death point never exceeding 52° C. Plant pathogens causing leaf-spot, canker, soft rot, gall, wilt or blight.

GENERA

1. *Chlorobacter* nov. gen.

syn. *Pseudomonas* (Partly) Migula
emend Dowson

Organisms producing green fluorescent water-soluble pigment; 1 to several polar flagella; gram-negative; mostly entering hosts through natural openings; gelatin generally liquefied;

starch hydrolysed; non-lipolytic; acid but no gas in several mono and di-saccharides; salicin not fermented; M.R. and V.P. tests negative. Plant pathogens primarily producing leaf-spot and canker of leaves, stems, fruits and branches, rarely blight.

Type sp.—*Chlorobacter syringæ* (van Hall) nov. comb.

2. *Phytobacterium*² Magrou and Prevot
syn. *Pseudomonas* (Partly) Migula
emend Dowson

Same as 1 above, except that the organisms are white; not fermenting lactose.

Type sp. *P. fabae* (Yu) Magrou and Prevot

3. *Xanthomonas* Dowson

Water insoluble yellow pigment producing organisms, causing leaf spot, canker and rarely blight.

4. *Agrobacterium* Conn.
Causing hypertrophy.

5. *Erwinia* Winslow, et al. emend Patel and Kulkarni
Causing blight.

6. *Pectobacterium* Waldee
Causing soft rot.

7. *Aplanobacter* Smith emend Patel and Kulkarni (syn. *Corynebacterium* Lehmann and Neumann)
Causing wilt.

Grateful acknowledgement is made to Drs. B.B. Mundkur and M. J. Thirumalachar for valuable suggestions. A detailed paper giving reasons for such a change in the nomenclature of the phytopathogenic bacteria will shortly be published.

Plant Path. Laboratory, M. K. PATEL.
College of Agriculture, Y. S. KULKARNI.
Poona 5,
June 6, 1951.

1. Bergey, et al., *Manual of Determinative Bacteriology*, 1948, 6th ed. 2. Magrou Joseph and Andre R. Prevot, *Compt. Rend. Acad. Sci. (Paris)*, 1948, 226, 1229-30.

AXIAL GRADIENT IN THE WATER CONTENT OF THE BODY-WALL OF EARTHWORMS

It has been well established that different regions of the body of Oligochætes are not on the same physiological level and that they exhibit a kind of gradient pattern in their metabolism, behaviour, responses, etc., which has been termed by Child¹ as an "U-shaped" gradient pattern—'a convenient designation for a gradient pattern in the longitudinal axis

with two high ends and a low region between them' (p. 120).

So far the evidence for the existence of such a gradient pattern is based on: (i) differences in the oxygen uptake and CO₂ production of pieces of body-wall from different regions of earthworms²⁻⁷; (ii) differences in the rate of dye-reduction at different body-levels of earthworms and microdilous oligochætes^{8,9}; (iii) differential susceptibility in microdilous oligochætes¹⁰; (iv) electro-potential,¹² and galvanotactic reactions¹¹, and effects of heat shortening at different body levels¹⁴ of earthworms.

Attention was drawn by Hatai¹⁴ to another feature which also showed the U-shaped gradient pattern, but of the inverted type, i.e., with two low ends and a high region between them. He found a difference in the water content of small pieces of the body wall from different regions of the body of earthworms, *Pheretima* (= *Perichæta*) *divergens* and *P. megascolidioides*; (Fig. 1, D, E). The investigations of Kopenhaver¹⁵ also showed the presence of a gradient pattern in this respect in *Lumbricus terrestris* and *Helodrilus* (= *Allolobophora*) *caliginosus*, but this gradient was markedly different from that found by Hatai in that there was a regular antero-posterior increase in the percentage of "free" or "unbound" water in the body wall of the species examined (Fig. 1, C, F). In view of these divergent results obtained by Hatai and Kopenhaver, a re-investigation of this problem was undertaken.

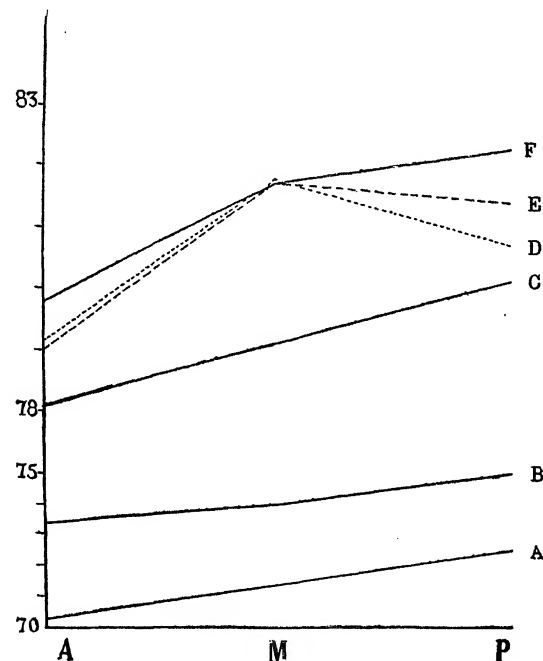
Estimations of the water content of approximately equal pieces of the body wall, consisting of 15-20 segments, from different regions, pre-clitellar, slightly post-clitellar and rectal, of *Pheretima posthuma* and *Lampito* (= *Megascolex*) *mauritii* were carried out by desiccating them over sulphuric acid, as was done by Kopenhaver, and, also, by drying them in a hot air oven at 100° C. for 3-4 hrs., in which time the weight became constant and remained so for over 17 hrs.

Six of the results, out of a series of twelve consistent estimations, for each worm by each method, are given in Table I as percentage of water in 100 gm. of tissue. The results, by both the methods, exhibit a regular antero-posterior increase in the water content of the body-wall (Fig. 1, A, B).

The present results agree with the results of Kopenhaver and, for this feature, we can almost be certain of the existence of this particular type of gradient pattern in all earthworms.

TABLE I
(as grammes of water in 100 gm. of body wall)

	Dried over sulphuric acid			Dried at 100° C.		
	Anterior	Middle	Posterior	Anterior	Middle	Posterior
<i>Pheretima posthuma</i>						
1	75.33	76.05	76.69	76.28	76.38	78.02
2	72.21	73.24	74.96	73.40	73.57	75.27
3	73.71	74.12	76.50	72.24	73.39	74.10
4	73.46	73.91	74.65	73.55	73.90	74.37
5	73.31	73.34	73.59	71.54	73.35	74.04
6	71.32	72.96	73.36	73.16	73.45	74.19
Average	73.22	73.93	74.95	73.36	74.00	74.99
<i>Lampito mauritii</i>						
1	71.67	73.60	74.02	75.75	76.61	77.94
2	72.83	73.03	73.52	70.78	71.73	72.93
3	73.99	74.33	75.90	69.75	70.06	70.96
4	72.48	73.05	73.88	69.74	70.90	72.03
5	69.55	70.80	71.53	68.33	69.96	71.15
6	69.75	70.76	71.37	67.12	68.73	70.00
Average	71.71	72.59	73.37	70.24	71.33	72.50



Amount of water in 100 gm. of body wall from the anterior, middle and posterior regions of the body of earthworms.

- A, *Lampito mauritii*; B, *Pheretima posthuma*;
C, *Helodrilus caliginosus*; D, *Pheretima divergens*;
E, *P. megascolidioides*; F, *Lumbricus terrestris*.

Since a species of the genus *Pheretima* also has now been shown to possess the antero-posteriorly increasing gradient pattern, the difference in the manner of growth of *Pheretima* on one hand and *Lumbricus* and *Helodrilus* on the other, which was suggested by Kopenhaver to account for the different results obtained by herself and Hatai, cannot be held valid. At the same time the other cause, namely, the difference in the methods of estimations, also cannot be held to account for the difference, as one set of estimations in the present investigation was by a method identical with the one employed by Hatai and the results obtained by it agree with those obtained by drying over sulphuric acid.

It will be observed from Fig. 1 that the water content of each region of *P. posthuma*, and also of *L. mauritii*, is appreciably lower than that of the corresponding region of *P. divergens* and *P. megascolidioides*, as well as those of *L. terrestris* and *H. caliginosus*, indicating that the integument of the Indian (Lucknow) worms is drier than that of the Japanese and American ones. This may, probably, be due to the general dry conditions of the earth in India as compared with that in Japan and Illinois, U.S.A.

The author is thankful to Professor K. N. Bahl, under whose guidance this work was done, for critically going through the manuscript and his constant encouragement.

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Lucknow,
June 9, 1951.

B. K. TANDAN.

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EFFECT OF MANGANESE ON THE INTENSITY OF MAGNESIUM LINES IN A DIRECT CURRENT ARC SPECTRUM

It is well known that great care is necessary in the selection of suitable lines for the quantitative estimation of an element, as one constituent may have considerable effect on the spectral line intensities of other constituents in a soil matrix. While investigating the conditions (using H. S. copper electrodes) suitable for the quantitative estimation of manganese in soils, a suppression in the intensity of a magnesium line is observed and the preliminary results are given below.

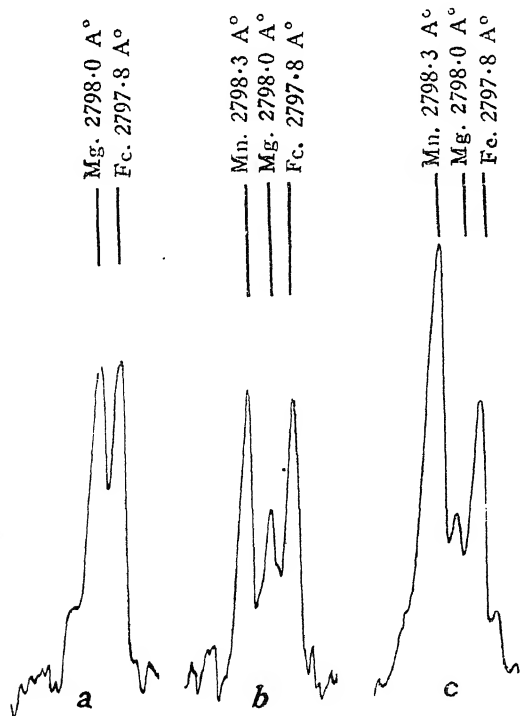
The moderately intense lines, 2801.1 Å., 2798.3 Å., of manganese were often used for the quantitative measurements by earlier investigators^{1,2,3}. Among these two, the line 2798.3 is free from interference, particularly in soils, and is therefore selected in the present investigation. It has, however, two other lines one of magnesium, 2798.0 Å. and the other of iron, 2797.8 Å., close by, but these three could

be easily resolved in the spectrum taken with an automatic large quartz spectrograph used.

Synthetic soil base,⁴ containing 2% magnesium oxide and 5% iron oxide was prepared and seven mixtures containing 50, 100, 200, 500, 1000, 1500 and 2000 p.p.m., manganese were made out of it. These finely ground mixtures were made into consistent pastes with dilute nitric acid and then arced on copper electrodes of 5 mm. diameter at 6.5 amperes arcing current. the arcing conditions were kept constant throughout the investigation. The microphotometric records of the spectra recorded in the 2300 Å. region for three samples arced, are given in Fig. 1. The magnesium line 2798.0 Å., recorded in the spectrum obtained using the soil base, Fig. 1a, is found to be as strong as the neighbouring iron line 2797.8 Å., taken as the internal comparison standard. The base is free from manganese contamination as no line due to manganese could be recorded. In the spectrum obtained with a mixture containing 50 p.p.m., manganese, Fig. 1b, the appearance of the manganese line is followed by the suppression in the intensity of the magnesium line 2798.0 Å., as compared to the intensity of the internal standard iron line which remained almost unaltered as desired under constant conditions of arcing. This suppression was observed in the spectra recorded for the rest of the samples also and the relative intensities of the two lines, more or less, remained the same as in Fig. 1c., for all the samples studied.

It is possible that the intensity of the manganese lines also might have been affected relative to the iron standard but with the present data it is difficult to assess that. The other magnesium lines in the neighbourhood viz., 2802.7 Å., and 2795.5 Å., are too strong to throw any light while the weaker lines 2790.8 Å., 2776.7 Å., and 2781.4 Å., seem to be suppressed. A detailed study of the intensities of the lines and the interactions between the atoms in an arc is in progress.

Indian Agric. Res. Inst., C. DAKSHINAMURTI.
New Delhi, B. RAMAMOORTHY.
February 21, 1951.



Suppression of Magnesium line by Manganese in the arc Spectrum of a Synthetic Soil Matrix.

- a. Synthetic Soil Base
b. Soil Base with Manganese 50 p.p.m.
c. " " " 200 p.p.m.

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A NOTE ON THE ABNORMAL DIURNAL VARIATION OF THE RECEIVED FIELD INTENSITIES

DURING the course of a study of the diurnal variation of the field intensities of the short-wave transmissions of the Madras (7260 kc/s), Calcutta (7210 kc/s, 6010 kc/s) and Bombay (7240 kc/s) stations of All India Radio during the hours 0700 and 0900 Indian Standard Time, some abnormalities were noticed and one of them is reported in this note.

In figure below is presented a typical curve of the diurnal variation of the received field intensities of the above three stations. From the curve it may be seen that the Calcutta and Bombay signals show a like variation whereas the Madras signals exhibit a characteristically different trend. Elsewhere¹ it has been shown that the normal trend of the diurnal variation of the received field intensities for medium distances is to vary with the zenith distance of the sun, the intensities decreasing with time up to noon. This course is followed by the Calcutta and Bombay signals. The intensity of the Madras signals is generally constant or shows a very small variation while the corresponding variation in the field intensities of Calcutta and Bombay signals is by -6 and 8 db respectively.

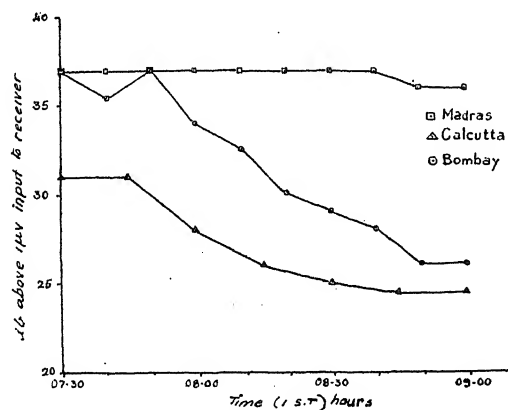


FIG. 1

It is now well known that the D-layer² is responsible for the daytime attenuation of the ionosphere-supported transmissions and one will, therefore, be tempted to associate the abnormal behaviour of the Madras signals to a dissimilarity in the D-layer over Waltair-Madras route and the other routes.

The existence of a geomagnetic control of the Ionosphere was first suggested by Appleton³ to explain the apparent anomalies in the criti-

cal frequencies of the F₂ layer at stations scattered all over the world. These anomalies disappeared when they were classified according to magnetic dip instead of geographical latitude. Subsequent work^{4,5} also seems to lend support to this view.

Though Madras does not differ widely in geographic latitude from Calcutta or Bombay it does so in magnetic dip value, this being 11° for Madras and 20° and 31° 45' for Bombay and Calcutta respectively. Further, Madras is nearer the magnetic equator than the other two places, being situated on the 3° N magnetic latitude. It therefore seems reasonable to attribute the abnormal diurnal variation of the field intensity of the Madras signals to some sort of geomagnetic control of the lower regions of the Ionosphere. Complete details will be published elsewhere.

Wireless Research Labs. Y. V. SOMAYAJULU.
Physics Department,
Andhra University, Waltair,
January 31, 1951.

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6. Baral, Ghosh and Debray, *ibid.*, 1948, **161**, 24.

TRYPSIN INHIBITOR IN FIELD BEAN (*DOLICHOS LABLAB*)

DURING the course of an investigation on the digestibilities of germinated pulses (unpublished work), the proteins of field bean (*Dolichos lablab*) were found to be very resistant to tryptic digestion. It was thought that the apparent non-digestibility of these proteins may be due to the existence of a factor in the pulse which strongly inhibits the tryptic activity. The existence of a trypsin inhibitor in soybean and in navy bean has been reported by Ham and Sandstedt¹ and by Bowman² respectively. So it was felt to be of interest to see whether a similar type of inhibitor is also present in field bean and also to study the effect of germination on the same. With this in view, a reaction mixture consisting of 40 c.c. of 5% skimmed milk solution, 5 c.c. of 2% trypsin solution, 5 c.c. pulse extract and 10 c.c. of phosphate buffer (pH 7.7) was kept at 37° C. and the extent of hydrolysis in one hour was estimated by formol titration using 10 c.c. aliquot of the reaction mixture. Proper controls were performed. The pulse extract was prepared by grinding 10 gm. of the pulse with 25 c.c. of the buffer and squeezing the meal through cloth. Table I represents results of a typical experiment:—

TABLE I
Percentage inhibition of tryptic activity by field bean extract

Experiment				Percentage inhibition
1	Skimmed Milk + trypsin			0
2	"	+	ungerminated pulse extract	81.39
3	"	+	" (autoclaved)	22.5
4	"	+	" (heated in water-bath for 10 min.)	60
5	"	+	" (heated in water-bath for 20 min.)	47.5
6	"	+	" (heated in water-bath for 1 hour)	10.0
7	"	+	soaked pulse extract (soaked for 12 hrs.)	80.0
8	"	+	24 hrs. germinated pulse extract	70.0
9	"	+	48 hrs. " "	79.48
10	"	+	72 hrs. " "	74.35

It will be seen from the table that (i) the field bean contains a trypsin inhibitor, the concentration of which does not increase on germination, (ii) the activity of this inhibitor gradually decreases on heating in a boiling water-bath; in one hour the activity falls from 81.39 to 10%, (iii) the inhibitor loses its activity on autoclaving for 20 minutes at 15 lbs. pressure; in this case there is an activation of the tryptic digestion.

Preliminary trials showed that the trypsin inhibitor of field bean could be extracted with 5% sodium chloride, dilute hydrochloric acid or water. However, 0.05 N hydrochloric acid was found to be a more suitable solvent and hence in subsequent experiments for isolating the inhibitor, this strength of the acid was used.

The inhibitor was isolated by extracting it with 0.05 N HCl. The filtrate was half saturated with ammonium sulphate. The precipitate was suspended in water and dialysed for 40 hours at room temperature in a cellophane bag against running tap water. The contents of the dialysing bag were centrifuged. The inhibitor was found to be present in the supernatant liquid. The supernatant liquid was divided into two equal portions. One portion was precipitated with alcohol and the other with acetone. The precipitate was washed with alcohol or acetone as the case may be, and finally with ether. It was dried *in vacuo* over phosphorous pentoxide. The degree of purity of the inhibitor attained at different stages of isolation was determined by calculating the inhibitor units. One unit of trypsin was taken, as defined by Anson,⁴ as the amount which digests hemoglobin under standard conditions at an initial rate such that there is liberated per minute an amount of split products not precipitated by trichloroacetic acid which gives

the same colour with phenol reagent as one milliequivalent of tyrosine. In these investigations, casein was used as a substrate and the experiment was carried out at 37° C. The inhibitor unit as defined by Borchers *et al.*³ as that amount which will reduce the activity of trypsin from one trypsin unit to 0.75 trypsin unit has been used in this investigation. The results are given in Table II.

TABLE II
Degree of purity of the inhibitor at different stages of isolation

Stage of Isolation	Inhibitor units per mgm. of the preparation
	$\times 10^{-6}$
HCl extract	139.8
Dialysed extract	695.05
Acetone precipitate	871.3
Alcohol precipitate	931.3

It will be seen from Table II that the final preparation is about 6 to 7 times purer than the HCl extract, and that alcohol precipitation results in a better preparation of the inhibitor.

The inhibitor does not affect the peptic activity nor does pepsin destroy it.

Dept. of Biochemistry, M. K. GAITONDE.
Institute of Science, KAMALA SOHONIE.
Bombay,
April 16, 1951.

1. Ham and Sandstedt, *J. Biol. Chem.*, 1944, **154**, 505.
2. Bowman, *Proc. Soc. Expt. Biol. Med.*, 1944, **57**, 139.
3. Borchers, R., Ackerson, C. W., and Sandstedt, R. M., *Arch. Biochem.*, 1947, **12**, 367.
4. Anson, M. L., *J. Gen. Physiol.*, 1938-39, **22**, 79.

REVIEWS

Memoirs of My Working Life. By Sir M. Visvesvaraya. Published by the author, 'Uplands', High Ground, Bangalore. Price Rs. 6.

The one aim in life of the author has been "to plan, promote and encourage developments chiefly in education, industries, commerce and public works to enable the people to work well, earn well and live well".

This book is a record of his endeavours in pursuit of this aim. He has achieved notable success in many spheres. As irrigation and sanitary engineer, he won laurels in early life in the Bombay Presidency and then as Special Consulting Engineer in Hyderabad and as Chief Engineer in Mysore. Long before T. V. A. was conceived, Sir Visvesvaraya executed the multipurpose development of the Cauvery River consisting of a storage reservoir of 48,000 million cubic feet of water, 150,000 acres of irrigated lands and hydroelectric installation of 80,000 H.P. It required unusual boldness, vision and administrative ability to set up an iron and steel works based on the use of charcoal in the Mysore State. Such faith can achieve the impossible; and today, Mysore is very much the richer for the trust her Government and people have reposed in him.

For more than three decades after retirement from Public Service, Sir M. Visvesvaraya has devoted himself incessantly to the task of developing the resources of the land, both human and material, with the utmost intelligence, enterprise and vision. At the age of 90, fired by the divine discontent that his people still continue to be "slow, sleepy and easygoing", he is as active as ever, preaching the doctrine of intelligent and disciplined work, of self-help, and of risk-taking. May his countrymen profit by his advice and his example! Then, they may be sure that the dawn of new life, which was ushered in four years ago, will break into a bright day of prosperity and happiness.

J. C. G.

Theory of Probability. By M. E. Munroe. (McGraw Hill Book Company, Inc., New York, U.S.A.), 1951. Pp. viii + 213. First Edition. Price \$ 4.50.

This book is an attempt to give a semi-rigorous presentation of the modern theory of

probability in its true flavour, with the concept of the stochastic variable leading on to the Central Limit Theorem and the weak and strong Laws of Large Numbers. The whole performance is mostly at the undergraduate level and forms an admirable Introduction to Cramer's "Mathematical Methods of Statistics" and Uspensky's "Introduction to Mathematical Probability," of which this work is a mild and digestible version. There is a delightful and wide variety in the examples discussed, from the standard game at Monte Carlo played with a wheel containing 37 equally spaced slots and the probabilities of gene types to the random walk problem dealing with the probable position of an aimless itinerant, tests for extra-sensory perception, radio-active disintegrations and the normality of a decimal expansion. To assist computations in probability theory, the author has provided the formulæ of Beta and Gamma functions with reasonable proofs and has also ventured to the depths of Stirling's theorem in the form $n! = n^{n+\frac{1}{2}} e^{-n} \sqrt{2\pi} e^{\epsilon_n}$ where $1/(12n+6) < \epsilon_n < 1/12n$ and $\int_{-\infty}^{\infty} (\sin x/x) dx$.

We are just given a glimpse of some high peaks in the distance like the law of Iterated Logarithms and Lindeberg-Feller Central Limit Theorem, through informal discussions. Elucidation of the properties of convergence in probability and their applications to sampling as well as the significance of the Bernoulli, Normal and Poisson distributions form the cream of the book.

On the whole, it is a highly informative and stimulating work. It should prove a worthy guide to the young student aspiring to climb the austere heights of modern Statistical Theory. There are as many as 300 exercises set to satisfy the plodder. We recommend this book strongly to all students and teachers of Statistics in our Universities.

Print, paper and figures are of the high excellence expected of a McGraw Hill publication. The reviewer has been able to detect only one misprint (i.e., on page 175, $\sqrt{2m-1+z}$ should read $\sqrt{2m-1} + z$).

A. A. K. AYYANGAR.

Elasticity. (McGraw-Hill Book Company, New York), 1950. Pp. v + 283. Price \$ 6.00.

This volume contains the proceedings of the third symposium in Applied Mathematics of the

American Mathematical Society held at the University of Michigan from June 14th to June 16th, 1949. It is a collection of 17 full length papers presented at the Symposium and represents recent developments in certain Sections of Elasticity and Plasticity made by specialists in these fields. Compared to the two previous volumes of this series, this contains more readable matter.

The contributors to the volume include I. S. Sakolnikoff, Eric Reissner, B. R. Seth, D. L. Holl, H. Poritsky, W. Prager and P. S. Symonds. The subjects treated include anisotropic problem, finite strain, bending of thin shells and plates, and elastic-plastic straining.

The book is wholly a reference volume and will be useful to mathematicians, physicists and engineers interested in the theory or application of Elasticity.

B. R. SETH.

Text-book of Organic Chemistry. By Louis F. Fieser and Mary Fieser. (D. C. Heath & Co.), 1950. Pp. 332. Price \$ 6.00.

The volume under review is intended for a one-year introductory course in organic chemistry. It maintains the high standard that one expects in books written by Prof. Fieser. The development of the subject-matter is the same as in the second edition of the larger book *Organic Chemistry* by Prof. and Mary Fieser. The present book is, however, more concise and being intended for an introductory course, topics on biochemistry, technology and reaction mechanisms have either been deleted or considerably abridged. The treatment of the subject follows the same pattern as the larger book by the authors. The order in which different organic compounds are presented is conventional except in the case of aliphatic acids which precede aldehydes and ketones in the present as also in the larger book by Fiesers. The chemistry of functional derivatives of aliphatic acids is not discussed separately unlike most text-books on organic chemistry; chapters on aliphatic cyanide and nitro compounds and on sulphur compounds should have been included. The subject-matter included in Chapter 12 on "Ring Formation" is rather heterogeneous; thus it includes other topics such as dicarboxylic acids, β -keto acids, tautomerism and hydroxy acids.

The chemistry of aromatic compounds is dealt with very satisfactorily. In the list of dye intermediates from naphthalene, J-acid, H-acid, and γ -acid should have been included. The book contains a chapter on heterocyclic com-

pounds which is a welcome addition to the subject-matter discussed in the larger book by the authors. Unfortunately in spite of the increasing importance of heterocyclic chemistry it has been dealt with rather sketchily, a defect which is common with many other text-books on organic chemistry.

Among the very few inaccuracies which were noticed are: Patent claims as regards chlorination of Indanthrone in the 3:3'-positions have yet to be substantiated; in fact 3:3'-dichloroindanthrone is prepared synthetically from 3-chloro-1-bromo-2-aminoanthraquinone or 1:3-dichloro-2-aminoanthraquinone (see p. 634). Flavanthrone is not technically prepared from 2-aminoanthraquinone by the action of antimony pentachloride (see p. 634).

The chapter on physiologically active compounds is a remarkably comprehensive account of such diverse and extensive subjects as, vitamins, water-soluble and lipid-soluble factors, steroids, chemotherapeutic agents including arsenicals, antimalarials, sulpha drugs and antibiotics such as streptomycin, aureomycin and chloramphenicol.

Each chapter begins with a useful tabular summary of compounds and their properties, such as m.p., b.p., sp. gr., pKa or pKb (in the case of acids and bases). The printing, diagrams, equations and formulas are excellent. The equations also include such useful data as the important reactants employed, temperature and yields. At the end of each chapter a summary of the subject discussed in the chapter is given—an innovation which is highly recommended as it will assist the student in his ability to assimilate the fundamentals of the subject and also to revise it in a short time. Thus, the student can compile his own summary of the chapter and then compare it with the author's summary. This will ensure his capacity to reproduce known facts. The summary is followed by problems whose solutions are given at the end of the book. These fulfil the second step in the assimilation of the subject, viz., application of established knowledge to the study of the unknown. The reading references which follow are of help not only to the beginner but also to the advanced student. Information on bond distances, bond energies, resonance energies, properties of solvents, electronegativity values and inductive effects is given at the end of the book in tabular form.

The book is an extremely valuable addition to text-books on organic chemistry, especially for Junior and Senior B.Sc. students.

B. D. T.

Industrial Microbiology. By S. C. Prescott and Cecil G. Dunn. Second Edition, (McGraw-Hill Book Company Inc., New York), 1949. Pp. xii + 923. Price \$8.50.

The first edition of this well-known volume on Industrial Microbiology was issued in 1940, and during the decade that has passed numerous advances in the fundamental and applied aspects of the subject have been made, thanks particularly to the rapid and spectacular expansion of the fermentation industry in the U.S.A.

The authors have taken advantage of the new edition of the volume to include these advances and bring the subject up to date. Among the features of the new edition attention should be invited to the complete revision of the chapters on yeast and its products. The latest information on riboflavin production has been included. Five new chapters on saccharifying agents, yeast production and yeast products, production of 2, 3 butanediol, itaconic acid and antibiotics, have been added. There is nearly a 70 per cent. increase in the volume of scientific matter included in the new edition.

The authors have rendered a great service to the subject of industrial microbiology by publishing this new edition. We have used this as a text for advanced training in Fermentation technology and as a constant book of reference in the course of our researches. This is a volume which will be gratefully welcomed by every student of applied microbiology.

Vitamins and Hormones, Vol. VIII. Edited by R. S. Harris and K. V. Thimann. (Academic Press Inc., New York), 1950. Pp. xi + 342. Price \$ 6.80.

The eighth volume of the series 'Vitamins and Hormones,' edited by R. S. Harris and K. V. Thimann, contains eight articles, four on the subject of vitamins and the rest on hormones. The subject-matter of these articles have been carefully chosen and presented in such an elegant fashion, that the high standard attained in previous volumes has been well maintained. The first article on 'Animal Protein Factor and Vitamin B12 in the Nutrition of Animals,' has been written in an exceedingly clearcut manner by T. F. Zucker and L. M. Zucker and several controversial issues ably presented. In view of the rapid advances in this field, however, one has soon to supplement this information by recourse to recently published papers on the subject. 'Pyridoxine in Relation to Fat Metabolism' has been written by H. Sherman from Harris' Laboratory, with particular emphasis on the inter-relationship which exists between this vitamin

and the unsaturated fatty acids, while the third article by W. J. van Wageningen and R. Wulzen, gives in detail the physiological and chemical aspects of the anti-stiffness factor essential for the guinea pig. 'Vitamins and Metabolism in Neurospora' by H. K. Mitchell, is an article which describes among other things the recent advances made on the manner of biosynthesis of some of the water-soluble vitamins using several Neurospora mutants for the purpose. 'The Physiology of Relaxin' by F. L. Hisaw and M. X. Zarrow, 'Interactions between Estrogens and Progesterone' by R. Courrier, 'The Physiological Actions of the Hormones of the Posterior Lobe of the Pituitary Gland' by R. L. Stehle, written as Part II of the article, published in an earlier volume of this series, and lastly 'Steroid Configuration' by C. W. Shoppe comprise the four articles on hormones. They have been written by authorities in the respective fields and are very interesting and thought-provoking in their scope and content. A few more articles could have been usefully included on interrelationship among vitamins and hormones in this volume, in view of the growing importance of the subject in recent years. However, the volume as such is quite valuable and should prove a real acquisition to all those who are interested in the twin subjects of vitamins and hormones.

P. S. SARMA.

Poisons. Their Isolation and Identification. By Frank Bamford. 3rd Edition; Revised by C. P. Stewart. (London: J. & A. Churchill Ltd.), 1951: Pp. viii + 316. Price 25 sh. net.

The third edition of this book, the first and second editions of which appeared in 1940 and 1947 respectively, is practically a reprint with minor additions and alterations. There has been some additions in the section on barbiturates. Earlier editions dealt with relatively smaller number of these compounds which came within the purview of the author. The present edition describes a more recent and comprehensive method for their identification based primarily on colour reactions. It also describes a volumetric method and a colorimetric method for estimating small amounts of arsenic in tissues. Another addition, unimportant though from a practical toxicologist's point of view (for whom this book is primarily meant), is a few short hints it contains on the antihistaminic drugs. A few useful changes in the general plan of the book have been made, e.g., gaseous and volatile poisons have been dealt with in the same chapter; the chapter on methods of isolation of organic poisons precedes their systematic testing.

The subject-matter of the book has been largely drawn from the author's rich practical experience in the isolation and identification of poisons in human poisoning cases, a subject of highly specialized nature. This book is not meant for theoretical reading or as a text-book. But, in the hands of a trained chemist who intends taking practical toxicology as his profession, this book should prove a very useful guide.

Insecticides, World Health Organization's Technical Report Series, No. 34. Pp. 82. Price 4s. 3d.

The report constitutes the beginning of what will probably become an international manual on insecticides and spraying apparatus.

The first section of the report deals with disinsectization methods for quarantine purposes, making specific recommendations concerning procedures for the disinsectization of aircraft and ships. It suggests, however, that sanitary regulations governing the routine disinsectization of aircraft and ships apply only to "areas suspected of being infested with insect vectors of disease... to such a degree that they represent a danger to other countries." Annexes to the report provide itemized time and cost estimates for various quarantine operations.

A major part of the report is devoted to specifications for insecticides and their formulations, including technical DDT, technical benzene hexachloride (12-14% gamma BHC), gamma-isomer benzene hexachloride concentrates (90% and above), technical chlordane (agricultural and refined grades), methoxychlor, wettable powder concentrates of DDT and BHC, and DDT emulsion concentrates. Packing and marking of packages are also recommended for each insecticide. Annexes describe test procedures for determining the chemical composition and physical characteristics of the various insecticides, e.g., the Winter, Parr peroxide-bomb, and Stanow methods for determining total organic chlorine content; the polarographic and chromatographic methods for determining gamma-isomer content of technical BHC; maximum diameter (particle size) determination, agglomerate test, settling rate, and tropical storage tests for DDT wettable powder concentrates; and flash point determination (TAG Closed Tester and Cleveland Open Tester methods) for DDT emulsion concentrates.

A section on spraying apparatus gives detailed specifications for knapsack/compression sprayers, hand sprayers, and stirrup pumps.

This report should be a valuable tool for all who are concerned with environmental sanitation and the control of insect-borne diseases, as well as for manufacturers, buyers, and users of

insecticides and spraying apparatus for their application.

Bulletin of the Central Research Institute, University of Travancore, Trivandrum. Series A, B and C. 1950.

There are excellent reasons why every University should have a Bulletin of its own, particularly in the field of the Sciences. Not the least perhaps is the one connected with the great pressure on space in Journals of an all-India character. The University of Travancore therefore deserves our heartiest commendation for bringing out the opening numbers of the series this year. A scrutiny of its contents shows that great care has been taken to maintain a high standard in the selection of papers for publication.

The Tuberculosis Association of India—

(1) *Twelfth Annual Report, 1950*; (2) *Proceedings of the Twelfth Annual General Meeting, 1951*; (3) *Directory of the Tuberculosis Institutions in India—1950.*

The first two publications summarise the activities of the Association and make brief references to certain developments in the anti-tuberculous campaign undertaken by the Central and State Tuberculosis Associations and Governments during 1949 and 1950. One of the most important activities has been the Seal Sales Campaign. This campaign, has created a mass consciousness against tuberculosis, which is as important as, if not more so, than cash returns. The magnitude of the tuberculosis problem in India can be gauged from the fact that it claims a victim almost every minute, and for every case of death there are at least five spreading the infection. Besides the emphasis laid on the preventive measures such as B.C.G. vaccination, an effective Tuberculosis Service including the isolation, treatment and rehabilitation of tuberculosis patients and the development of a Social Service Organisation, it is gratifying to note the welcome approach towards "Research in Tuberculosis". The Association has realised that India should not merely be a borrower in the scientific markets of the world but should earnestly undertake this important phase of anti-tuberculosis work". "The Directory of the Tuberculosis Institutions in India, 1950." provides useful and reliable information about sanatoria, hospitals, dispensaries and medical institutions where facilities for treatment of tuberculous patients exists. It is a comprehensive and up-to-date guide and the Association has to be congratulated on making the Directory available to the public,

M. SIRS,

British Scientists. By E. J. Holmyard. (Published by J. M. Dent & Sons, London). Pp. viii + 88. Price 6 sh. net.

In the handy little volume under review, Professor Holmyard has briefly but skilfully touched upon the landmarks in the history of British Science from the very earliest days well into the first half of the present century also. Representative of the various stages in the story of its development, names of great scientists have been chosen as chapter headings with a view to indicate the part played by them. The nature of the contents as well as the method make it clear that this is more the biography of British Science than of British Men of Science. Even so, its merit as a biography is *par excellence*, judged by all standards, both literary and scientific. Excellently produced and tastefully illustrated, the volume can be heartily recommended to everyone who would like to recapture the really great moments in the evolution of British Science.

Books Received

Plane Analytic Geometry. An Intermediate Course, 1st Edition, by A. B. Shah & Apte, M., Poona 2, 1951, pp. vi+252, Price Rs. 5-8-0.

Studies on the Natural Fats, Vol. I, Parts I-III. Summary of Ph.D. Thesis, 1949, by A. R. S. Kartha, Ernakulam, 1951, Pp. 145, Price Rs. 5.

Soil Science. An Elementary Text-Book. I Edition, by A. N. Puri, M/s. Minerva Book Shop; The Mall, Simla, 1951, Pp. 156, Price Rs. 8.

Principles of Fruit Preservation, 3rd Edition. Revised by T. N. Morris, 1951, Pp. xiii+203, Price, 21 sh. net, M/s. Chapman & Hall, London W.C. 2.

Austenitic Grain-Size Control of Steel, by B. R. Nijhavan & A. B. Chatterjee, C. S. I. R., 1951, Pp. 58, Price Rs. 3.

Laboratory Manual of Qualitative Organic Analysis, 2nd Edition, by H. T. Openshaw, M/s. Cambridge University Press, 1951, viii + 94, Price 8sh. 6d.

The Oxide Coated Cathode, by G. Herrmann and S. Wagener. M/s. Chapman & Hall, 1951, Pp. viii+148, Price 21sh. net.

Organic Chemistry, by J. P. Wibaut, Elsevier Publishing Co., Ltd., 1951, xvi+660, Price 55sh.

The Chemistry and Technology of Food and Food Products, by M. B. Jacobs, M/s. Inter Science Publishers, 1951, Pp. xxv+832, Price \$ 12-00.

Sugar Industry Annual, 1950, M/s. M. P. Gandhi & Co., 1951, lxxviii + 156, Price Rs. 6.

South African Scenery (A Text-Book of Geomorphology), by L. C. King, M/s. Macmillan & Co., 1951, Pp. xxxi + 379, Price 45sh. net.

SCIENCE NOTES AND NEWS

A New Collection of Fossils from the Suket Shales (Vindhya).

Sri. R. C. Misra, Dept. of Geology, Lucknow University, writes as follows:—

It may be recalled that the collection of certain discoidal fossils from the Vindhya by Mr. H. C. Jones of the Geological Survey of India in the field session 1907-08 evoked considerable interest. These fossils were variously identified as primitive brachiopods and plant remains. The author has made further collections in October, 1950, from the area and has discovered new forms, which when studied in detail, might yield interesting results. A number of new localities where such fossils occur in extraordinary abundance have also been discovered.

Prof. M. S. Thacker

Prof. M. S. Thacker, Director of the Indian Institute of Science, who has left for the U.S.A.

under Truman Point Four Programme, will be visiting various engineering and other research centres, and is expected to participate in the National Technical Conference on Illumination Engineering (Washington) and the First World Metallurgical Congress (Detroit). While returning he will be visiting U.K., France, Germany and Switzerland for consultations, equipment, etc., relating to the Institute.

Historic Observatory of Tycho Brahe

Astronomers and astrophysicists from many countries have been invited by the Swedish Astronomical Society to the island of Ven between Sweden and Denmark, to commemorate the 350th Anniversary of Tycho Brahe on 14th October of this year.

The celebrations will include the re-inauguration of Tycho-Brahe's observatory, Stjerneborg, which is now being excavated, while the excavation of Uraniborg, another Brahe

observatory situated at some 100 yards from it will be carried on later (UNESCO).

International Symposium on the Reactivity of Solids

The Royal Swedish Academy of Engineering Sciences and the Chalmers' University of Technology have decided to arrange an international symposium in Gothenburg during 9th to 13th June, 1952, for discussing problems concerning the reactivity of solids.

Professors G. W. Brindley, G. Chaudron, V. Frechette, P. Gilard, O. Hahn, J. A. Hedvall, P. Niggli, G. M. Schwab, P. Schwarzkopf and W. Steger are expected to participate in the preliminary programme. All communications regarding the symposium should be directed to Mr. Lennart Simonsson, Royal Swedish Academy of Engineering Sciences, Box 5073, Stockholm 5, or to Professor J. A. Hedvall, Chalmers' University of Technology, Gothenburg.

Symposium on the Social Relations of Science

The Delhi Branch of the Association of Scientific Workers of India proposes to convene a symposium on the above subject in the beginning of September this year. Those who would like to participate in the symposium may please write to Shri M. L. Aggarwal, Secretary, Delhi Branch, Association of Scientific Workers of India, 1/3, Kishen Nagar, Karol Bagh, New Delhi.

Dr. Bharucha

Dr. F. R. Bharucha, Acting Principal and Professor of Botany, Institute of Science, Bombay, has been elected a Member Correspondent of the *Svenske Vartgeografiska Sällskapet*, Uppsala, Sweden. He is the first Indian Botanist to be so elected.

Dr. Bharucha has also been elected to the Editorial Board of *Vegetatis*, an International Journal of Phytogeography, Holland.

Award of Research Degree

On the recommendation of the Board of Examiners consisting of Professors R. W. B. Pearse, R. F. Barrow and W. Jevons, the thesis entitled "Electronic Transitions in Substituted Benzenes in the near Ultra-Violet" by Sri. K. Sreeramamurthy, M.Sc., has been declared qualified for the Degree of Doctor of Science of the Andhra University.

Prof. R. S. Krishnan

Prof. R. S. Krishnan who is now in Europe to participate in two international con-

ferences, will be giving a series of lectures in Egyptian Universities in September of this year.

Indian Mathematical Conference

The Seventeenth Conference of the Indian Mathematical Society will be held in Bangalore in the last week of December, 1951, under the auspices of the University of Mysore. Members who wish to read papers should send abstracts, not exceeding 300 words, to Dr. K. Chandrasekharan, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay 1, before the end of October, 1951.

Mr. B. Rama Rao

After a long and meritorious service rendered to the country as Geologist and Mining Engineer, Mr. Rama Rao, former Director, Indian Bureau of Mines, has now retired from active service.

He was the President of the Geology and Geography Section of the Indian Science Congress in 1936, and also of the 6th Geographical Conference in the same year, and of the Geological, Mining and Metallurgical Society of India in the years 1942 and 1943. Mr. Rama Rao was also a Delegate of the International Geological Congress held at Washington (U.S.A.) in 1933.

Annual Essay Contest—His Excellency Raja Maharaj Singh Certificate

The Division of Food Information and Statistics of the Central Food Technological Research Institute, Mysore, announces that H. E. Raja Maharaj Singh Certificate will be awarded this year to the best essay on "Future of Canning Fruits and Vegetables in India". The essay should not be more than 4,000 words in length and should be submitted by the 31st December 1951 to the President of the All-India Food Preservers' Association, 18-A, Aurangzeb Road, New Delhi.

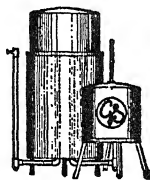
Indo-German Industrial Co-operation

The Government of India have received offers for 50 Free Studentships at German Universities and Technological Institutes and also for training of a number of Indian engineers and apprentices in workshops of heavy industries in Germany. As a measure of reciprocity, the Government of India have decided to award 10 Free Studentships to Germans for the study of Indian Languages, Religion and Philosophy at Indian Universities.

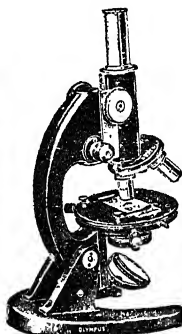


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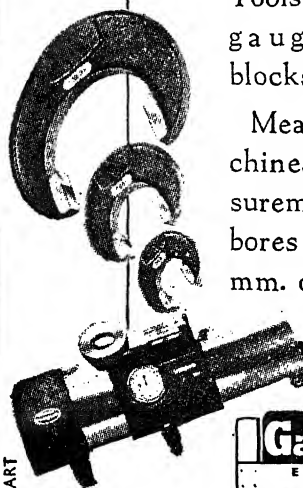
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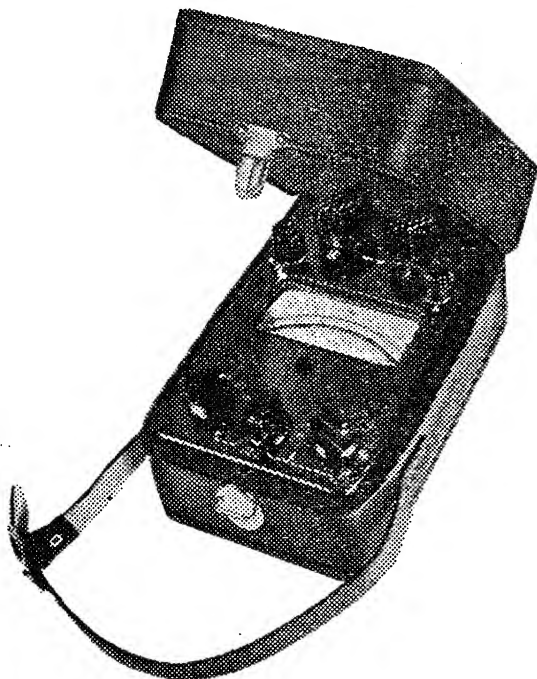
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Current Science



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AUTOMATIC CONTROL*

THE conception of automatic control arises basically from the use of devices which measure the departure of the physical state of a system from a desired normal, and the utilisation of this information to restore, by mechanical or electrical means, the system to the normal state. Many and varied devices of this kind have existed for a long time. Every steam engine had its governor and a patent was filed for a D.C. cross-field generator to give constant current as far back as 1882. The automatic pilot was flying aeroplanes in 1925 and one of the several fields of automatic control that was already entering upon a phase of active development before the war was that of the automatic control of quantities involved in the manufacture of chemical products, the field now often referred to as process control. What is new is the emergence in recent years of a philosophy of automatic control, a change of out-

look based on the recognition of a common basis of principle in a great variety of engineering devices. And it is precisely this recognition that is mainly responsible for the present acceleration of progress in all the many fields of application from sensitive self-balancing bridges for measuring purposes to power machinery like rolling mill drives.

It is probable that the development of the feed-back thermionic amplifier was the decisive contribution in weaving these various strands of development into a unified pattern. The main theoretical concepts that enable us to deal so effectively with so large a variety of control problems were nearly all first developed in connection with the use of feed-back in amplifiers. It was in this connection that Nyquist, in 1932, developed the criterion of stability now known by his name, that has played so important a part in the development of all forms of automatic control.

The perception of the essential identity of the basic problems in these various fields was accelerated by the pressure of war requirements. The rapid solution of many automatic

* Abstract of the Presidential Address of Sir Ben Lockspieser, at the opening of the D.S.I.R. Conference on Automatic Control at the Royal College of Aeronautics, Cranfield, England.

and manual control problems became of first importance, as may be appreciated on recalling such examples as the automatic gun layer, the automatic tracking of targets or the control of guided missiles. The solution of these problems led to the production of many new elements suitable for use in control systems. But the outstanding result of the stimulus of war on the development of automatic control was this appreciation, for the first time, of the essential unity of the subject, including mechanical servo-systems, automatic controls as used in the chemical industry, feed-back amplifiers, both of the thermionic, rotary-machine and static-magnetic types, and in fact the possibility of bringing under the control of a common scheme of analysis all those systems in wide fields of engineering and elsewhere that involve what is called a 'closed sequence of dependence.'

The scope of this conception was soon seen to extend even beyond engineering. There is no doubt that in biology, in economics, and perhaps even in still wider fields, this conception of the closed sequence of dependence, and the characteristics of system behaviour associated with it, may prove to be a valuable tool of thought, and in some cases a means to the formulation of problems in these difficult fields in such a way that the analytical methods already worked out by engineers may be brought to bear on them.

The subject of automatic control is of outstanding importance, both in connection with industrial development and the increase of pro-

ductivity, and also with defence requirements. Writers of eminence have not been lacking, particularly in the United States, who have seen in the development of automatic control systems an important contribution to the emergence of an entirely new type of industrial era. There is some disparity between such views of the future potentialities of automatic control and the somewhat slow, though steady and important progress that has been made so far in the application of automatic controls in industry.

It may be true that if economic considerations are set aside, there are now only remote limitations to the technical possibilities of devising mechanisms that will carry out certain kinds of functions usually performed by human muscular skills, but, in fact, the economic considerations remain and it is an important purpose of a Conference of this kind to make the sort of progress that in the long run will result in the production of simple and, therefore, cheaper equipment. Several of the papers to be discussed during the Conference are concerned with the alternative ways in which a given specification of requirements may be met and the possibilities of devising procedures in design that will indicate the optimal design without the inordinate amount of labour and calculation that is at present involved in the design of such systems. Such developments, if they can be carried to a successful conclusion, will also help to cheapen the application of automatic control and so widen its field of use.

INTERNATIONAL COMPUTATION CENTRE

THE International Computation Centre proposed by the UNESCO is to have the following functions in the fields of Research, Education and Service:

(1) to organise study and scientific research on questions relating to the use and development of Mechanical Computation devices, in particular to establish, in co-operation with scientific organizations concerned, a programme of pure science problems to be studied on the international level; to publish and circulate in appropriate form the results of the research which it has undertaken; to promote collaboration between computing institutes throughout the world, to assist in the co-ordination of their work, and to promote their activities;

(2) to organise and develop a programme for the training and improvement of research

workers in the field of Mechanical Computation; and, to this end, establish and maintain one or more laboratories equipped with various types of calculating machines and requested to carry out numerical computations.

Also it has been recommended that UNESCO should create and administer the Centre and should secure for it the resources necessary for its functioning. The proposed budget for the first year is \$220,000, mounting to \$300,000 in the third year.

Three countries—Italy, the Netherlands, and Switzerland—have offered to act as host for the proposed Centre, but no decision is to be made until a final report is presented to a suggested meeting in November of accredited delegates from different countries when the Centre will be set up officially.

A RATIONAL METHOD OF APPLYING SULPHATE OF AMMONIA TO RICE

K. RAMIAH, M. V. VACHHANI AND C. T. ABICHANDANI

(Central Rice Research Institute, Cuttack)

RICE is a semi-aquatic plant and is mostly grown in swampy and anaerobic condition. A large number of investigations has been conducted to evaluate the response of the crop to the application of nitrogenous fertilizers. Among such fertilizers, sulphate of ammonia has been found to be the best, though the response may vary with different soil and other environmental conditions, (Sethi;¹ Ramiah *et al.*²). According to Dastur *et al.*,³ rice plants unlike other crops uses ammoniacal nitrogen in early stages and nitrate nitrogen in later stages of its growth. Field experiments with a mixture of ammonium nitrate and ammonium sulphate did not however establish the superiority of the mixture over sulphate of ammonia.

Efficient use of fertilizer can result only when the fertilizing element is utilised by the plant to the maximum extent. The present method of applying sulphate of ammonia to rice throughout India consists of spreading the fertilizer on the surface in wet condition immediately after transplanting the crop or somewhat later. Immediately on application, ammonia which is in the most reduced condition of the nitrogenous compounds is partly utilized by the plant directly and the rest is converted into nitrates by oxidation. Nitrate which is the highly oxidized form of the nitrogenous compounds does not undergo any further change in the surface layer and since it is not absorbed by the soil colloids, it leaches down to the lower layer with the percolation water and some of it is drained off with the free water. Russell⁴ states that the work of Prof. Pearsel has indicated that under marshy conditions oxidation takes place only near the soil surface and reduction down below. The nitrates formed on the surface when they get down to the lower reductive layer are reduced and gaseous nitrogen in the form of NO or N₂ is formed which is lost. Thus there is loss of nitrogen both as nitrates and free nitrogen gas and the full benefit of the fertilizer application is not obtainable.

The practical aspects of this finding have been recognised and made use of by Japan in their rice manuring practices.⁵ In Japan, two-thirds of the nitrogen dose as sulphate of ammonia is applied in the dry condition of the soil 2"-3" below the surface a few days before water is let into the fields for puddling and transplanting. The other one-third is ap-

plied later when the plant is growing and even here, the sulphate of ammonia is first made into balls or pellets mixed with clay, and these are thrust into the soil a few inches deep. Their investigations have shown that ammonium sulphate applied directly in the reductive layer remains stable and the plant utilizes it gradually. Thus the loss of nitrogen is minimized and it has been estimated that the efficiency of sulphate of ammonia applied in this way is 50-70 per cent. as against 20-30 per cent. only with the usual wet application.

To test this method of 'dry' application in the lower layers an experiment has been conducted at Central Rice Research Institute, Cuttack, under medium and low land conditions during two crop seasons, 1949-50 and 1950-51. The quantity of nitrogen applied was 20 lb. per acre and the application of nitrogen resulted in a significant increase in yield, the response being about 268 lb. of grain over a control yield of 1667 lb. per acre. Between the two methods of applying sulphate of ammonia, on the surface of wet soil or 2-3 inches below the surface in dry condition, the latter has given a consistently higher response though the differences between the two methods were not always significant. The average yield response for the two methods per lb. of nitrogen applied is given below:

TABLE I

Average of response of paddy in lb. per acre for every lb. of N applied

	Dry application	Wet application
Medium land	.. 14.2	9.4
Low land	.. 19.3	11.9
Mean	.. 16.8	10.7

The above data clearly indicate that the dry method of applying sulphate of ammonia is more efficient than the usual wet method.

In large rice areas of N. E. India, Assam, Bihar, Bengal and Orissa, rice is sown in the dry condition of the soil at or just before the break of the monsoon. Under such conditions, the application of sulphate of ammonia in the dry soil inside the plough furrows does not present any difficulties and should prove more efficient than later application when the monsoon is on in full swing. Where however the land

is not ploughed in the dry condition but puddled after first letting in the water, this dry application is not feasible.

To meet this situation another experiment on deep placement has been conducted at Central Rice Research Institute for two seasons. The required amount of sulphate of ammonia was mixed with 5 to 10 times its weight of soil and made into a soft dough with water. Small balls of about 1" in diameter were then made from this material and dried. These balls were thrust 2"-3" deep into the soil between rows of standing crop 12"-18" apart at the time of weeding in a transplanted crop or at the time of bushening in a broadcasted crop. It has been found that this method of application is much more efficient than the wet surface application as shown by the figures given in Table II.

The efficiency of the deep placement is 2.5 times that of the surface application. There is an indication that the response for 20 lb. N placed deep can be just as good as 40 lb. N applied on the surface.

While the detailed results of these trials will be published elsewhere, the experiments are

TABLE II
Results comparing 20 lb. of nitrogen applied as ammonium sulphate either on the surface or deep-placed

	Earheads per plant	Mean height per plant (cm.)	Yield lb. per acre	
			grain	straw
No nitrogen	.. 5.3	115.8	1575	1926
Surface application	.. 5.8	120.5	1698	2089
Deep placement	.. 6.3	126.0	1895	2395

being continued and arrangements are also in progress to test the dry application and deep placement on a large scale in the cultivators' fields.

1. Sethi, R. L., *I.C.A.R. Bull.*, 1943, No. 38.
2. Ramiiah, et al., App. II (b) to *I.C.A.R. Report on soil fertility investigations in India*, 1947, by Dr. A. B. Stewart.
3. Dastur, et al., *Ind. Jour. Agri. Sci.*, 1933-34, 3, 963, and 4,803.
4. Russel, E. J., *World Crops*, 1949, 1, 2, 72-6.
5. Dr. Morinaga, *Unpublished note*.

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

IN the course of his address at the opening of the Indian Institute of Technology, Kharagpur, the Hon'ble Maulana Abdul Kalam Azad observed as follows:

"The Institute which is being inaugurated today will have provision for the teaching of 2,000 students at the undergraduate level, and 1,000 students for post-graduate study and research drawn from all over the country.

"In order to ensure that the Institute serves the needs of the country in the most effective manner, the course in the Institute will be planned on the advice of experts drawn from industry, Government Departments, other employing agencies and educational authorities. In fact, this close association between academic experts and practical administrators is essential for the proper development of an institution of this type. I would like to make a special appeal to our industrial and business magnates to take an active interest in the development of this Institute. They can help in many ways. Industry can assist financially by establishing Chairs in subjects in which it is especially interested. Such assistance would make it possible to have Professors, where necessary more than one, in subjects which are important from the point of view of the development of industry. I have no doubt that in-

dustrialists will also help to make the training in this Institute more practical and concrete by permitting students to visit Workshops and Factories and allowing them to go through organised courses of practical training in the industry. It will improve the quality of teaching in the Institute, and in the end help industrialists themselves, if staff members of the Institute are offered facilities for the study of industrial techniques. Promising employees should also be seconded to the Institute to undertake programmes of research or courses at the post-graduate level. Last but not least, industrial magnates can help by deputing engineers, technologists, and administrators in their concerns to deliver lectures or courses of lectures at the Institute.

"Though situated in one corner of India, this Institute is intended to cater to the needs of the country as a whole. We have been able to recruit very distinguished men to take charge as Professors in the different departments, and we are happy that a scientist of the calibre of Dr. J. C. Ghosh is its first Director. I have no doubt that they will devote themselves to building this institution on sound foundations so that it may take its place as one of the finest institutions of its kind not only in India but in the world."

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INCOMPLETE BLOCK DESIGNS

IN connection with a recent note¹ by A. A. K. Iyengar in *Current Science*, it appears that while writing the note, the author had not with him the information on two earlier important papers by Bose² and Shrikhande.³ Bose² has used the same method of matrix representation to prove that $b \geq v$. Shrikhande³ has also used virtually the same principles to prove the impossibility of certain symmetrical balanced incomplete block designs, of which the example, $v = b = 46$, $r = k = 10$, $\lambda = 2$ quoted by Ayyangar is a particular one. Further, the symmetrical determinant NN' of Bose and Shrikhande is exactly the same as the determinant $X'X$, which

was used earlier in connection with "weighing designs".^{4,5}

Pusa, Bihar,
June 13, 1951.

K. S. BANERJEE.

1. Krishnaswamy Ayyangar, A. A., 1951, 20, 93.
2. Bose, R. C., *Annals of Math. Stat.*, 1949, 619-20.
3. Shrikhande, S. S., *Ibid.*, 1950, 106-11.
4. Banerjee, K. S., *Ibid.*, 1948, 394-99.
5. —, *Ibid.*, 1949, 300-04.

THE geometry of finite projective planes initiated by Veblen and Bussey, the Incomplete Block Designs due to Fisher and Yates and the weighing problem of Yates and Hotelling have a common mathematical basis, which has been

worked out by many recent writers in several journals. The matrix representation $X = \{x_{ji}\}$ plays a fundamental part in all of them, as also its sequel, the determinant $|X'X| = A$ first used by Harold Hotelling¹ in his basic paper in 1944. This paper has been the inspiration of subsequent developments by Mood Kishen, Banerjee and others.

The determinant $|X'X|$ was next thought of by Bruck and Ryser in 1949 to prove the non-existence of certain finite projective planes² and by Ryser to prove a property of incomplete block designs.³ While reviewing Schützenberger's theorem⁴ in the *Mathematical Reviews*, 1950, 11, 3, H. B. Mann points out that the proof can be considerably simplified by computing AA^T instead of A directly. I had not noticed this remark prior to my historical note⁵ where I had referred to the shorter proof of Chakrabarthi which is just on the lines hinted at by Mann.

More recently, Chowla and Ryser,⁶ following the earlier work of Bruck and Ryser have given simple and elementary methods of proof which lead to results more comprehensive than those in Schützenberger's.

A. A. KRISHNASWAMI AYYANGAR.

Mysore,
August 4, 1951.

1. Harold Hotelling, *Annals of Math Stat.*, 1944, 15.
2. Bruck, R. H., and Ryser, H. J., *Canadian J. Math.*, 1949, 1.
3. Ryser, H. J., *Proc. Amer. Math. Soc.*, 1950, 1.
4. Schützenberger, M. P., *Annals of Eugenics*, 1949, 1.
5. Ayyangar, A. A. K., *Curr. Sci.*, 1951, 20.
6. Chowla, S., and Ryser, H. J., *Canadian J. Math.*, 1950, 2.

KIRTHAR FORAMINIFERA FROM RAJASTHAN

KIRTHAR foraminifera have been described from Western Pakistan,¹ Cutch² and Kathiawar. The *Pellatispira* bed of the Surat-Broach area to which an Upper Eocene age has been assigned³ is considered to be post-Kirthar and the new name *Tapti* series⁴ has been suggested for the *Pellatispira*-bearing beds of India, Pakistan and Burma. In Rajasthan the only Eocene horizon hitherto recognised is the Laki equivalents of the Bhadrar beds of the Salt Range containing *Assilina daviesi*, *A. spinosa* and *Orbitolites complanata*. *N. irregularis* has not been recognised in these beds. The present discovery of beds containing Kirthar foraminifera from Kolayat, near Bikaner, is of considerable interest. The Kirthar beds are here exposed as outliers surrounded by Laki beds

which seem to be the continuation of the Palana Laki sequence.

The Kirthar beds have yielded the following foraminifera:—*N. cf. maculatus*, *Discocylinna* (sellate forms), *Dictyoconoides cooki*, *Flosculina* sp., *Linderina* sp., *Planorbulina* sp., *Heterostigina* sp. This fauna is distinct from that of the Laki, and the presence of *N. cf. maculatus*, Nuttall² fixes the age as lower part of the Middle Kirthar.

Investigation of this fauna (under the guidance of Mr. S. R. Narayana Rao) is in progress and detailed account will be published elsewhere.

Department of Geology,
Lucknow University,
May 12, 1951.

S. N. SINGH.

1. Davies and Pinfold, *Pal. Ind. N. S.*, 1937, 24, (1).
2. Nuttall, *Rec. Geol. Surv. Ind.*, 1926, 59, Pt. I, 115-64; Vredenburg, *Ibid.*, 1906, 34, 79-95.
3. Narayana Rao, *Journ. Mys. Uni.*, Sec. B, 1941, 2, (2), 5-17.
4. Eames, *Abstr. Proc. Geol. Soc.*, London, No. 1463, 30-341; Nagappa, *Proc. Ind. Acad. Sci.*, 1951, 33, 41-48.

CLOUDED FELDSPARS IN BASIC DYKES OF CHARNOCKITIC AREAS

It will be seen from the geological map of the Mysore State published by the Mysore Geological Department, or from the geological sketch map of the Biligirirangan area given by Mr. B. Rama Rao,¹ that there are a few prominent dolerite dykes running west to east, and, therefore, trending almost at right angles to the prevailing north to south strike of the rocks of this region. These dykes cut both the Peninsular gneisses and the Charnockites. Many of these dykes have chilled margins and so must be considered later in age than the country rocks.

During a recent visit, specimens of the basic dykes of this area were collected by the writer, and when thin sections of these rocks were examined under the microscope, it was found that the plagioclase feldspars, without any exception, exhibited the phenomenon of clouding.

This cloudiness of the feldspars is not to be confused with the turbidity caused by decomposition. The clouded feldspars of the Biligirirangans are not altered but quite fresh, and the multiple twinning of the plagioclases are seen distinctly between crossed nicols.

In ordinary transmitted light, thin sections of clouded feldspars are either brown or grey in colour. Under high power, this cloudiness is seen to be caused by the presence of very fine inclusions which are in the form of minute

specks or tiny rods. There is usually no uniformity either in the depth or in the distribution of clouding even in a single crystal. The discoloration, therefore, is found to be somewhat patchy. Sometimes, these microscopic specks or rods are arranged in streaks parallel to the traces of the twinning planes. In some of the dykes the clouded feldspars also contain acicular inclusions disposed at angles of 60° and 120°, features considered to be characteristic of the charnockites.²

Apart from the Biligirirangan area, there is another region in the Mysore State which is characterised by the occurrence of charnockites. This lies in the south-west of the State comprising the area south of Fraserpet in Coorg, and west of Periyapatna. The basic dykes here were microscopically examined, and it was seen that the plagioclase feldspars were clouded.

A preliminary examination of thin sections of dykes occurring in the charnockitic area south-west of Sakleshpur in the Hassan District, and near Sivasamudram in the Mandya District, has shown that practically all the dykes there contain plagioclase feldspars which are clouded to varying degrees of intensity.

This naturally led the writer to investigate whether the dykes in charnockite areas outside Mysore State also contained clouded feldspars. It has not, of course, been possible to examine all the dykes of these regions but brief visits to Pallavaram, Mettur and the Nilgiris enabled the collection of some of the dykes occurring in these typical charnockite zones. Every one of these dykes when examined under the microscope was found to be characterised by the presence of clouded plagioclases.

Sir Thomas Holland's description of one of the dykes in the Shervaroys—another typical charnockite area—leaves no room to doubt that when he states "the plagioclase is generally brown through included dust",³ he is referring to the phenomenon of clouding.

During a recent visit to Ceylon, the writer scoured the highlands, which is charnockitic, for basic dykes but was unable to locate any. The dykes on the coastal plain, which are mainly in gneissic country, do not contain clouded feldspars.

The phenomenon of clouding in plagioclase feldspars has become a valuable criterion in the elucidation of the metamorphic history of a region ever since A. G. MacGregor¹ drew attention to the fact that clouding in plagioclases is produced in a rock that has been subjected to regional—or contact—thermal metamorphism, and that it is not an original feature of the feldspar crystallisation period, or a deuteric

effect that arose at a late stage in the consolidation period.

The dark colour of the charnockites is considered to be caused by the presence of acicular inclusions in the usually light coloured minerals, quartz and feldspar. The general association of dykes containing clouded feldspars with charnockites bearing greasy grey or blue quartzes and feldspars, requires explanation. As already stated, in some clouded feldspars in basic dykes the minute specks or rods give place to longer acicular inclusions. This seems to indicate that both the basic dykes and the charnockites have together suffered regional-thermal-metamorphism at some later date. The relative age as inferred from the chilled edges of the dykes, precludes the possibility of the charnockite intrusion having affected the plagioclases of these basic rocks.

C. S. PICHAMUTHU.

Mysore Geological Dept.,
Bangalore 1,
July 20, 1951.

1. Rama Rao, B., *Mys. Geol. Dept. Bull.*, No. 18, 1945, Plate III facing p. 105. 2. Holland, T. H., *Mems. Geol. Surv. Ind.*, 1900, 28, Pt. II. 3. —, *Ibid.*, 1901, 30, Pt. II, p. 131. 4. MacGregor, A. G., *Mineralogical Magazine*, 1931, 22, 524-37.

ON THE NATURE AND DISTRIBUTION OF PYROPHOSPHATASE IN GUINEA PIG TISSUES

EXCEPTING Lohmann¹ who, working with fresh liver extracts, reported a specific pyrophosphatase active only in the presence of magnesium, all other workers have failed to detect this potent enzyme because they have invariably subjected the tissue materials to various treatments like autolysis, dialysis, acetone desiccation, etc., before testing for pyrophosphatase activity. It is observed that all the above treatments are highly deleterious to this magnesium activable enzyme. Having been able to demonstrate the existence of a labile magnesium activable alkaline pyrophosphatase in erythrocytes² which was overlooked by the previous workers, and having found that plasma is practically devoid of this enzyme, it is considered likely that all tissues in which glycolysis is a constant occurrence might contain this enzyme. With this object, and since guinea-pig, of all the animals investigated, showed the highest erythrocyte pyrophosphatase activity³ the tissues of an adult guinea-pig were investigated.

Fresh extracts obtained by maceration of the tissues in glass mortars were used. The dilutions

varied from 50-150 times the wet tissue weight. The pyrophosphatase activity of these tissues was measured at different pH without and with added magnesium (0.02 M), using M/35 veronal-acetate buffer and an incubation period of 15 minutes at 40° C. The results obtained with brain, heart, intestine, kidney, liver, lung, muscle and testes indicate that all these tissues show pyrophosphatase activity at such great directions only in the presence of magnesium, and that the maximum activity is in the pH range of 7.2-7.9.

To find whether any activity could be observed without added magnesium by prolonged incubation, separate experiments were set up with an incubation period of 2½ hours and at 37° C. While all the other tissues show negligible activity, intestine and kidney show appreciable activity at pH 8.68. These activities may be due to the action of a separate enzyme.

The magnesium activable alkaline pyrophosphatases of the tissues show resemblance to the erythrocyte enzyme in many of their properties. With 0.001 M magnesium the activation is about 10% while with 0.005 M magnesium the activity reaches 90% of the maximum, which is observed with 0.02-0.05 M. Higher concentrations produce inhibition. Calcium acts antagonistically to magnesium. Preliminary incubation with the buffer without magnesium and pyrophosphate produces marked inhibition of the tissue enzymes. The presence of magnesium or pyrophosphate protects the enzymes against this buffer inactivation. Fluoride in low concentrations is toxic to all the enzymes. Formaldehyde inhibits the enzymes indicating thereby that intact amino groups are essential for the enzyme activity. Copper and mapharside are inhibitory, and the mapharside inhibition could be reversed with cysteine. The integrity of sulphhydryl groups is, therefore, necessary for activity.

It is, therefore, concluded that all tissues contain the same potent magnesium activable alkaline pyrophosphatase as that present in erythrocytes. In the following table are given

Tissue	Units	Tissue	Units
Bone	0.5	Muscle	4.5
Brain	10.2	Prostate	13.7
Heart	22.2	Seminal vesicle	17.1
Intestine	18.0	Spleen	9.8
Kidney	16.1	Supra-renals	8.6
Liver	53.3	Testes	61.0
Lung	9.0		

the results on the relative distribution of the enzyme in different tissues of an adult guinea-pig. Each unit corresponds to one mg. of orthophosphate P liberated by the enzyme present in 1 g. of the wet tissue.

The fact that bone which is the richest source for alkaline phosphomonoesterase shows negligible pyrophosphatase activity leads to the conclusion that pyrophosphatase is distinct from phosphomonoesterase, and that it has no role in ossification, but only in glycolysis.

Details will be published elsewhere.

Chemistry Department, B. NAGANNA,
Madras Veterinary College,
November 29, 1950.

1. Lohmann, K., *Biochem. Z.*, 1923, **262**, 137.
2. Naganna, B., and Narayanamenon, V. K., *Jour. biol. Chem.*, 1948, **174**, 501.
3. Naganna, B., *Unpublished*.

A RAPID FLUORESCENCE TEST FOR THE DETECTION OF ARGEMONE OIL IN MUSTARD OIL

IN 1941, Sarkar¹ first developed the specific ferric chloride test for the detection of argemone oil in mustard oil. This test with some minor modifications by Sen² can detect even 0.25% argemone oil in mustard oil. Since the ferric chloride test requires, sometimes, a fairly long time for the appearance of crystals, the authors have been trying for sometime past to develop a rapid but specific test. The following simple test has been found to be very useful.

1 c.c. of pure concentrated hydrochloric acid and 0.5 c.c. of ethyl alcohol (rectified spirit) are added to 2 c.c. of the suspected mustard oil in a test tube and shaken for about a minute. The test tube is then heated in a boiling water bath for about 10 minutes with occasional shaking and the contents then seen in ultra-violet light (a Hanovia fluorescence lamp has been used) in a dark room. The lower acid layer will exhibit a characteristic pinkish fluorescence if argemone oil is present in mustard oil even in 0.025% concentration. A large number of vegetable oils have been tested and the test has been found to be specific for all practical purposes.

If in the above procedure heating is omitted then the acid layer in the case of argemone adulterated mustard oil will exhibit a violetish fluorescence (bluish violet at very low concentrations and light violet at higher concentrations). The acid layer in the case of pure mustard oil or til oil under identical condition (in

cold) might show a fluorescence resembling that of the acid layer of about 0.0125% argemone oil in mustard oil immediately, but on keeping for a longer period the fluorescence will be distinctly different and there will be no difficulty in the detection of argemone adulterated mustard oil. For rapid result the heating procedure is recommended. Full details will be published elsewhere.

Our thanks are due to Indian Council of Medical Research for a research grant.

Dept. Org. Chem. & S. N. SARKAR.
Biochem., D. L. NANDI.
Nilratan Sarkar Medical College,
Calcutta,
February 12, 1951.

1. Sarkar, S. N., *Ann. Biochem. Expt. Med.*, 1941, **1**, 271; 1942, **2**, 101. 2. Sen, A. K., *Ind. Med. Gaz.*, **81**, 126; *Jour. and Proc. Inst. Chem.*, 1946, **18**, 102.

CARBONACEOUS EXCHANGERS BY SULPHONATION OF INDIAN COAL

CARBONACEOUS cation exchangers, obtained by sulphonation or alkaline oxidation of natural materials like coal, peat, lignite, etc., are well known and are available in market under various commercial names. However, few data are available on the systematic study of these processes.¹ The present work has been undertaken with a view to study the suitability of Indian coals and lignites for the preparation of carbonaceous ion exchangers. A sample of a medium-quality semi-bituminous coal was ground to (-20, +60 mesh), sulphonated at different temperatures for two hours, and then left overnight at room temperature. The final product (-20, +60 mesh) was regenerated with HCl, air-dried and stored in stoppered bottles. The moisture content was determined by heating at 102-107° to a constant weight, and the capacity due to strongly acidic sulphonic acid type groups, was estimated by finding the limiting exchange value with BaCl₂ solution.² The results were reproducible within 4% and the conclusions, from the data obtained till now are briefly summarised below:

(a) The capacity increases with the increase in the ratio of H₂SO₄ to coal, the ratio varying from 1 to 3.

(b) Sulphonation with 5% fuming sulphuric acid gives better results than those by ordinary sulphuric acid (d = 1.83).

(c) The capacity increases up to a sulphonation temperature of 90°, but further increase in temperature (to 200°) decreases the capacity.

(d) The use of catalysts, except MnO₂, did not increase the capacity.

(e) The prior treatment of the coal sample by solvent extraction did not appreciably change the capacity.

(f) The maximum values for capacity obtained so far were 1.5 to 1.55 m. eq./gm. bone-dry exchanger. The value obtained for 'Catex' (Infilco) under similar conditions was 1.47.

A detailed account will be published shortly elsewhere. Further work on the lignitic and other varieties of coal is in progress.

Nat. Chem. Lab. of India, S. L. BAFNA,
Poona 7, M. U. PAI,
May 28, 1951. H. A. SHAH.

1. Broderick, S. J., and Bogard, D., *U.S. Bureau of Mines Report of Investigations*, 1941, No. 3,559. 2. Heymann, E., and O'Donnell, I. J., *J. Colloid Sci.*, 1949, **4**, 395.

STUDIES OF A SYNTHETIC CATION EXCHANGE RESIN

BELOW are summarised briefly the results obtained from the study of a sample of cation exchange resin,¹ termed here as HP-6, with a view to determining the available replaceable hydrogen per gram of bone dry resin (dried to constant weight at 102° C.-107° C. in an air oven) in the hydrogen form (to be written further as HP-6H).

The dark brown resin, -20/+60 mesh, was "conditioned" by three cycles of exhaustion (NaCl 5%) and regeneration (HCl 5%) and finally the regenerated form HP-6H was air-dried and stored in a stoppered bottle. The ash was 0.0%. The moisture was determined by heating in an air-oven at 102° C.-107° C.) to a constant weight.

The results given below, estimated to be within ±1%, give milliequivalents of available replaceable hydrogen per gram of bone-dry resin HP-6H by different methods:

A. (a) by pH-titration curves² in presence of NaCl, at pH 7, = 2.27, at pH 11, = 2.84.

(b) by determination of ash (as BaSO₄) in the barium salt³ of the resin HP-6H, = 2.28.

(c) by determination of limiting exchange with BaCl₂ solution³ = 2.20.

B. By passing a solution of NaCl through the column of the resin and determining the acidity of the effluent,

(a) with N/2 NaCl (pH of last 50 c.c. effluent, 2.8) = 2.15

(b) " N/100 " (" 1000 c.c. effluent, 3.0) = 2.15,

A detailed account will be published shortly elsewhere.

Nat. Chem. Lab. of India,
Poona 7,
June 6, 1951.

S. L. BAFNA,
H. A. SHAH.

1. Ind. Patent, 44,359 (applied for by CSIR).
2. Topp, N. E., and Pepper, K. W., *J. Chem. Soc.*, 1949, 3299.
3. Heymann, E., and O'Donnell, I. J., *J. Colloid Sci.*, 1949, 4, 395.

PREPARATION OF ISO-MORELLIN

ISO-MORELLIN could be obtained only in 6% yield by the method of B. S. Rao¹ as modified by P. L. N. Rao and S. C. L. Verma.² It can be however prepared conveniently in about 50% yield by refluxing morellin in dry pyridine for 6 hours and crystallising the product from alcohol. It melts at 120-21° (B. S. Rao gives m.p. 116°); $[\alpha]_D^{25} = -555.9$ (c, 0.5125% in chloroform); semi-carbazone, a pale yellow product, decomposes at 192°.

Antibiotics Lab., P. L. NARASIMHA RAO.
Dept. of Biochem., S. C. L. VERMA.
Ind. Inst. of Sc., D. V. KRISHNA MURTHY.
Bangalore,
July 30, 1951.

1. *J.C.S.*, 1937, 853.
2. *J. Sci. and Ind. Research*, 1951, August issue (in print).

FRIES REARRANGEMENT OF β -NAPHTHOL ESTERS

SEN AND BHATTACHARJI¹ have published a note on the rearrangement of various aliphatic esters of β -naphthol under the conditions of the Fries reaction. Similar work has also been going on in our laboratory² and in view of the above note, we think it necessary to publish some of our results.

The Fries migration of β -naphthol esters has been hardly studied except for the acetate.³ We have systematically investigated the Fries migration of α - and β -naphthyl acetate as well as benzoate under various conditions, but only the results of the migration of β -naphthyl acetate and benzoate are presented here.

β -Naphthyl acetate isomerises to 1-acetyl-2-naphthol under the conditions of the Fries reaction. Besides this main product, a small quantity of another ketone (m.p. 150°) has been isolated from the reaction mixture. If this migration is carried out in nitrobenzene as solvent, the ketonic product, m.p. 150°, is not obtained, while carbon disulphide did not effect the migration at all. Zinc chloride instead of alu-

minium chloride gives at 140-50° a ketone which has been identified to be 6-acetyl-2-naphthol.

The Fries migration of β -naphthyl benzoate has been studied for the first time and the product obtained in small yield has been identified to be 1-benzoyl-2-naphthol. Nitrobenzene as a solvent yields the same ketone in better yield. It is noteworthy that unlike the transformation of β -naphthyl acetate, the benzoate migration gives only one product.

We have also investigated the effect of various factors on the course of the above migration. A detailed paper on the Fries migration of both α - and β -naphthyl esters is being sent for publication elsewhere.

The M. R. Science Institute, N. M. SHAH.
Gujarat College, G. G. JOSHI.
Ahmedabad,
June 5, 1951.

1. *Curr. Sci.*, 1951, 20, 132-33.
2. Shah and co-workers, *J. Indian C. S.*, 1946, 23, 199, 234; 1948, 25, 377; *et seq.*
3. *Ber.*, 1914, 47, 3216.

FRIES AND FRIEDEL-CRAFTS REACTIONS IN COUMARINS

IN continuation of the work on Fries reaction in coumarins,¹ the migration has now been studied in the case of esters of 6-hydroxy coumarins. Earlier Desai and Mavani² had observed that no transformation occurs with the acetyl and benzoyl esters of 6-hydroxy-4-methylcoumarin,² while 6-acetoxy-7-methylcoumarin smoothly undergoes this rearrangement.³

In the present case the observation of Desai and Mavani² on the failure of migration in the case of the esters of 6-hydroxy-4-methylcoumarin has been confirmed. Attempts to introduce acetyl or benzoyl group by the Friedel-Crafts method also met with failures. However, 6-acetoxy- and 6-benzoyloxy-coumarins easily underwent Fries transformation to furnish 5-acyl derivatives. Similar results were obtained on Friedel-Crafts acylation of 6-hydroxycoumarin with acetyl and benzoyl chlorides. As already stated by Desai and Mavani,³ this failure in the case of 4-methylcoumarin derivative may be due to the steric effect of the 4-methyl group.

Negative results were also obtained on attempting rearrangement of acetyl and benzoyl esters of methyl 5-hydroxy-4-methylcoumarin-6-carboxylate and methyl 7-hydroxy-4-methylcoumarin-6-carboxylate. Friedel-Crafts reaction with acetyl and benzoyl chlorides on these coumarins were also unsuccessful.* Similar

unsuccessful results in the Fries rearrangement of the esters of 3-acetyl or 3-carboethoxy-7-hydroxycoumarin have been obtained by Shah and Shah.⁴ This inhibitive effect may be the result of decrease in general electron availability in the molecule due to the presence of acetyl or carboxylic ester group.

In 6-hydroxycoumarin series, the work is being extended with a view to have more evidence on the bond structure of coumarin derivatives.⁵ It was observed that 6-hydroxy-7-methylcoumarin easily coupled with benzene diazonium chloride,[†] which would be expected considering the easy coupling of 6-hydroxy-4-methylcoumarin already observed.²

The work on diazo-coupling, Fries transformation and Claisen rearrangement in 6-hydroxycoumarins, with either 5- or 7-position occupied by an alkyl group, is in progress.

Organic Chemistry Lab.,
The Institute of Science, V. M. THAKOR.
Bombay,
June 27, 1951.

1. Thakor and Shah, *J. Indian Chem. Soc.*, 1946, **23**, 199, 234. 2. Desai and Mavani, *Proc. Indian Acad. Sci.*, 1942, **15A**, 1, 11. 3. —, *Ibid.*, 1947, **25A**, 327. 4. Shah, N. M., Private Communication. 5. Rangaswami and Seshadri, *Ibid.*, 1941, **14A**, 547; Shah, R. C., *Presidential Address (Chemistry)*, *Indian Science Congress*, 1951.

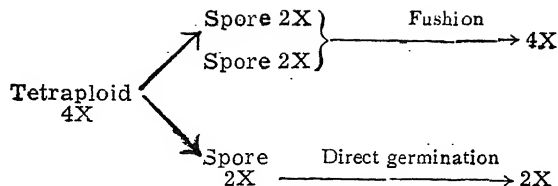
* Under Prof. R. C. Shah. † With R. N. Usgaonkar.

AUTOTETRAPLOIDY AND THE SO-CALLED INBREEDING DEGENERATION IN YEASTS

EVIDENCE for the existence of polyploidy in yeasts was offered from two angles. Using a two chromosome brewery yeast, a doubling of the chromosome complement was demonstrated cytologically after treatment with acenaphthene.¹ Later, it was possible to recover the diploid from the autotetraploid by culturing in a medium containing 16% alcohol.² This has enabled a rational interpretation of the so-called inbreeding degeneration claimed by Winge and Laustsen.³

If we assume (1) that the control strain of Winge and Laustsen is a tetraploid and (2) that there is no direct diploidization,² then their supposedly heterozygous culture is a tetraploid, while the homozygous strain is a diploid:

Wort agar slant 48 hr. old	one loop →	10 ml. wort in 100 ml. conical flask	contents transferred after 24 hrs. →	40 ml. wort in aerator	→	contents transferred after 24 hrs. →
				100 ml. wort in 500 ml. capacity aerator		



Support for such a probability is offered by Roman, Hawthorne and Douglas.⁴ Among sixty-four four-spored asci obtained from a cross between two clones of *Saccharomyces*, one exhibited an irregular ratio. They suggest that the spores from this ascus had a diploid constitution and that the cell from which the ascus arose may have been a tetraploid. These diploid spores gave rise by direct germination to clones the spores of which gave a 2 : 2 segregation. It is exactly this suggestion which was offered by Duraiswami and Subramaniam² to explain the so-called inbreeding degeneration observed by Winge and Laustsen.³

Winge and Laustsen claim that the lower yield of dry matter by the "homozygous" strain is the result of an inbreeding degeneration. If our interpretation is correct, then our autotetraploid and the diploid should yield different amounts of dry matter. Winge and Laustsen³ estimated the yields "at different times with varying duration of the experiments." The data presented by them is given below and the difference in yield has been calculated on a percentage basis.

Results of Winge and Laustsens (page 32) :

	mgm dry matter of yeast			
Heterozygous	52.0	66.0	69.6	67.6
Homozygous through nuclear fashion	34.6	48.0	57.8	56.0
Difference in mgm.	17.4	18.0	11.8	11.6
Culture No.	1	2	11	12
Heterozygous %	150.3	137.5	120.4	120.7
Homozygous				

It is found that the "heterozygous" strains yield dry matter about 20 to 50% more than the "homozygous" ones.

In our investigations, the diploid and the autotetraploid strains were propagated under conditions of vigorous aeration adopting the schedule indicated below.

The yeast crop obtained at the end of 24 hours was washed after centrifugation and the

dry weight determined after keeping at 90° C. overnight. A representative set of results is presented in the table.

Strain	Total yield (Dry weight)	% Difference in yield (BY 3/BY 1)
Diploid (BY 1)	0.714 g.	..
Autotetraploid (BY 3)	1.252 g.	75.3

There is a striking similarity in the two results indicating that the phenomenon of inbreeding degeneration is not implicated at all and that the homozygous strain of Winge and Laustsen³ may be a diploid originating by the direct germination of a spore having a balanced chromosome complement.

We are very thankful to the Council of Scientific and Industrial Research for generous financial assistance.

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Cytogen. Laboratory, K. K. MITRA.
Dept. of Biochemistry, M. K. SUBRAMANIAM.
Indian Institute of Science,
Bangalore. July 2, 1951.

1. Subramaniam, M. K., *Proc. Nat. Inst. Sci. (India)*, 1947, **13**, 129. 2. Duraiswami S., and Subramaniam, M. K., *Cellule*, 1950, **53**, 215. 3. Winge, O., and Laustsen, O., *C. R. Lab. Carlsberg, Ser. Physiol.*, 1940, **23**, 17. 4. Roman, H., Hawthorne, D. C., and Douglas, H. C., *Proc. Nat. Acad. Sci., U.S.*, **37**, 79.

COMMENTS ON THE ABOVE NOTE

THE opinion advanced by Duraiswami, Mitra and Subramaniam in the above note has already been set forth earlier by Duraiswami and Subramaniam, 1950, and I (Winge, 1951) have criticized their statement and several other peculiar hypotheses, advanced by Subramaniam and his collaborators.

As to the existence of polyploidy in yeasts I have never denied this possibility, and the observations by Roman, Hawthorne and Douglas (1951) seem distinctly to prove that they had in their material one tetraploid ascus out of a total of 64 giving four diploid spores. In each of the four single spore cultures they found spore formation and a regular Mendelian segregation from the asci of these single spore cultures.

Duraiswami and Subramaniam, on the other hand, have not made any spore isolations or hybridizations at all, and their cytological investigations are of a very doubtful nature. It is well known that there exists a distinct disagreement among different authors as to the

yeast chromosomes. It is extremely doubtful whether the bodies regarded by the Indian authors as chromosomes are chromosomes at all, as they are found scattered in the cytoplasm at all stages and in a varying number.

When now, once again, these authors attempt to prove that the yeast (Danish baking yeast) studied by us (Winge and Laustsen, 1940) was tetraploid and not diploid they apparently forget

(1) that our yeast has been shown to form regular 4-spored asci, and that the single spore cultures from these asci are (after diploidization) homozygous and constant (Winge and Laustsen, 1937). They are not *heterozygous* and do not segregate in the next generation as do the single spore cultures from the above-named ascus described by Roman, Hawthorne and Douglas.

(2) that we have demonstrated by direct observation that the spores of our baking yeast germinate in two different ways, some giving spherical, haploid cells, which must conjugate pairwise before they are able to form spores, and some giving directly diploid elongated cells, because the spores are or have become binucleate (Winge and Laustsen, 1937).

(3) that we have observed an inbreeding degeneration, however less pronounced, also when a diploid single spore culture arises through cell fusion (Winge and Laustsen, 1940, Table V).

(4) that our baking yeast has been crossed to other *Saccharomyces cerevisiae* types, giving normal fertile hybrids which sporulated normally. The spores from the hybrids germinated well, from 59% to 94%, giving normal, viable cultures (Winge and Laustsen, 1939).

This proves that our baking yeast is diploid and not a tetraploid variety, as Subramaniam and his collaborators so emphatically seem to maintain, without having made any experiments with our yeast at all.

Hence it is inadequate to assert that the decreased vigour we have observed in the offspring of the Danish baking yeast may be explained through a transition from a tetraploid to a diploid stage.

Carlsberg Laboratorium, Ö. WINGE.
Copenhagen, Denmark,
August 18, 1951.

1. Duraiswami, S., and Subramaniam, M. K., *La Cellule*, 1950, **53**, 215. 2. Roman, H., Hawthorne, D. C., and Douglas, H. C. *Proc. Nat. Acad. Sci., U.S.*, 1951, **37**, 79. 3. Winge, Ö., *Compt. Rend. J. Lab. Carlsberg, Sér. Physiol.*, 1951, **25**, 85. 4. Winge, Ö., and Laustsen, O., *Ibid.*, 1937, **22**, 90. 5. —, *Ibid.*, 1939, **22**, 337, 0. —, *Ibid.*, 1940, **23**, 17.

AN IN VITRO EVALUATION OF THE TUBERCULOSTATIC PROPERTIES OF SOME SULFONE DERIVATIVES

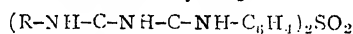
SINCE the early reports of Rist, *et al.*,¹ of the tuberculostatic properties of 4-4'-Diamino diphenyl sulfone both *in vitro* and in experimental animals, its efficacy has been confirmed but all reports emphasize its appreciable toxicity. Attempts made so far to develop sulfone derivatives of lower toxicity and greater efficiency than the parent substance have not been very encouraging.² The present study gives an account of the *in vitro* activity of the compounds against Myco. tuberculosis prior to their evaluation in experimental Murine tuberculosis.

The first series of compounds are the biguanido derivatives of diaryl sulfones and in the second group are the mono and bis thio-carbamido derivatives. Their chemistry has been published separately.

The experimental procedures were similar to those adopted for testing the tuberculostatic properties of antimalarial compounds.³ The simple synthetic media as defined by Youmans⁴ was the media of choice and the D₁₃ strain of Myco. tuberculosis isolated locally from a case of pulmonary tuberculosis using the trisodium phosphate technique⁵ was the test organism. Propylene glycol was used as a solvent for the water-insoluble compounds. The results were read at the end of 4 weeks and recorded as shown in Tables I and II.

TABLE I

Tuberculostatic properties of some biguanido derivatives of sulphones



R	Drug concentration $\mu\text{g/c.c.}$						
	100	10	5	2.5	1	.5	0

1	C ₆ H ₅ -	..	-	-	+	2+	2+	2+	2+
2	P·Cl·C ₆ H ₄ -	..	-	-	-	±	1+	2+	2+
3	P·Br·C ₆ H ₄ -	..	-	-	-	-	1+	-	2+
4	PI·C ₆ H ₄ -	..	-	-	-	-	2+	-	2+
5	P·CH ₃ ·C ₆ H ₄ -	..	1+	1+	2+	2+	2+	2+	2+
6	P·CH ₃ O·C ₆ H ₄ -	..	-	-	-	-	-	+	2+
7	D.D.S.	..	-	-	±	1+	1+	2+	2+

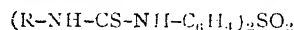
Legend: - No growth, ± faint growth, 1+ to 2+ various grades of growth.

The table indicates that compounds No. 3, 4 and 6 definitely show an increased activity over the parent D.D.S. and other bis-biguanido

derivatives. While compound No. 5 seems to have lost its activity by the substitution.

TABLE II

Tuberculostatic activity of mono and bis-thio carbamido derivatives of sulfones.⁷



R	Drug concentration $\mu\text{g/c.c.}$						
		100	10	5	2.5	1	0
8 C ₆ H ₅ -	..	-	-	±	1+	2+	2+
9 P·BrC ₆ H ₄ -	..	-	-	+	+	2+	2+
10 P·-IO C ₆ H ₄ -	..	-	-	-	-	±	2+
11 Allyl-	..	-	-	+	2+	2+	2+

Compound No. 10—4-4'-(Di-iodophenyl thio-urea) amino diphenyl sulfonate, exhibits a markedly increased activity almost comparable to the inhibitory action of P.A.S. on this strain of Myco. tuberculosis.

The compounds were synthesised at the Organic Chemistry Department of the Indian Institute of Science, Bangalore. Our thanks are due to Prof. Guha and Dr. S. C. Bhattacharyya for kindly offering the compounds. We acknowledge with pleasure the help given by Dr. N. N. De and Dr. K. P. Menon during the course of the investigations.

Pharmacology Laboratory M. SIRSI.
and Organic Chemistry B. N. JAYASINHA.
Laboratory, J. R. IYENGAR.
Indian Institute of Science,
Bangalore 3.
July 13, 1951.

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ACTIVE RELAXATION OF UNSTRIATED MUSCLE FROM MARINE ANIMALS

A CONVINCING example of active relaxation in unstriated muscle has been found in the retractor of the introvert of the marine worm *Golfingia* (Phascolopsis) *gouldii* (Pourtales). The four retractors are removed along with the brain and immersed unloaded in sea water contained in a petri dish. The brain is stimulated

by slight pressure with a forceps. This results in contraction and subsequent active relaxation of the muscles. In over 20 experiments, they relaxed by 100 to 200 p.c. of their length during contraction. In sodium cyanide (1 in 10,000), the muscles contract but active relaxation is absent. Microscopically, the muscles consist of longitudinal bundles of fibres.⁹

In *Mytilus* muscle, no active relaxation has been found. There is a difference in the contractile mechanisms of the above two muscles. In *Mytilus* muscle, barium chloride and sodium cyanide cause contraction of the contractile mechanism;^{7,8} in the muscle from the worm, these chemicals do not cause such marked contraction, but rather relaxation, more in sodium cyanide than in barium chloride. This muscle, therefore, in some respects resembles frog's and mammalian muscle, in which there is active relaxation.

Marine Biological Lab., INDERJIT SINGH.
Woods Hole,
July 27, 1951.

1. Singh, S. I., and Singh, I., *Curr. Sci.*, 1948, 17, 306.
2. —, *Proc. Ind. Acad. Sci.*, 1949, 30, 343. 3. —, *Curr. Sci.*, 1950, 19, 60. 4. —, *Ibid.*, 1951, 20, 48. 5. —, *Nature*, 1950, 166, 647. 6. —, *Proc. Ind. Acad. Sci.*, 1951, 33, 184. 7. —, *Ibid.*, 1949, 30, 270. 8. —, *Ibid.*, 1951, 33, 165. 9. Andrews, E. A., *Studies Biol. Lab.*, Johns Hopkins Univ., 1890, 4, 389.

INTERACTION OF TEMPERATURE AND DAYLENGTH ON FLOWERING IN WINTER PADDY, RUPSAIL

TABLES I and II show that after-sowing temperature conditions markedly influence the growth characters and the degree of earliness due to photoperiods. In September sowing, the ear emergence is extremely uneven,

the flowering duration of individual plants of the 6 weeks' short-day treatment varying between 67-189 days, with a large number flowering at intermediate dates. Tillers of individual plants flowered after long intervals, the panicles being shorter and spikelets fewer than those in the February sowing. On the other hand, in the February sowing, temperature had gradually increased and consequently flowering was more uniform and finished within 62-76 days.

It was noted that there was no grain setting in the main shoot or the tillers of the control and the treated plants which flowered at the temperature range below 83°-61°, but some of the tillers of the same plant flowering in March (temperature range above 89°-63°) had normal grain formation. This difference in the setting of grains leads one to conclude that after anthesis, a critical temperature (nearly 90° F.) is necessary for the formation of grains. Similar results were obtained by Went¹ with cultivated tomato fruits and Kondo and Okamura² with some Japanese varieties of rice.

TABLE I

Effect of photoperiods on the growth of a Winter Paddy, var. Rupsail in two sowings

		Av. height in cm. after the end of the short day treatment	Number of tillers produced in plants 20 weeks old	Number of leaves produced before ear emergence
September sowing :				
Treated	..	21.75	6.0	9.7
Control	..	26.23	3.2	13 to 16
February sowing				
Treated	..	49.23	18.4	10.1
Control	..	47.85	8.5	20

TABLE II

Effect of after-sowing temperature conditions on the flowering behaviour of Winter Paddy var Rupsail, treated with 8 hrs. short photoperiods for 6 weeks in two sowings.*

Sowing time	After sowing temperature conditions	Av. No. of days from sowing to ear emergence			Flowering duration in main shoot	Length of panicle		No. of spikelets in the panicle	
		Main shoot	1st tiller	2nd tiller		M St.	Till.	MSt.	Till.
21st Sept. 1947	.. Decreasing from a max. of 92°·9 F. and a min. of 81°·4.	82.0	108.5	153.8	67-189	8.8	10	13	19.4
25th Feb. 1948	.. Increasing from a max. of 90°·8 F. and a min. of 66°·8 F.	69.2	97.3	106.3	62-76	9.6	12.7	19.3	24.3

* The control plants of the September sowing flowered 135.6 days after sowing. Those in the February sowing flowered after 250 days.

A comparison of the ear emergence data of the two sowings throws some light on the flowering behaviour of this variety of *Aman* paddy. In the present and earlier investigations, it was seen that irrespective of the time of sowing, plants flower at about the same time, i.e., November 7, on which date the day length is 11 hrs. 13 mins. and this may be taken as the critical photoperiod of this variety. In Calcutta (Lat. 22° 35' N.), this comes again on Feb. 5 after reaching a minimum of 10 hrs. 45 mins. on Dec. 22-25. If Garner and Allard's hypothesis³ holds good, this variety should have another flowering time about this time. The control plants of the September sowing (none of which flowered in early November, probably due to short vegetative period after sowing winter conditions) were subjected to natural short photoperiods, and the induction was extremely uneven due to prevailing low temperature, but the average number of days from sowing to ear emergence was 137 (reaching up to February 5). Thus Winter, *Aman*, varieties are fixed for a particular daylength and not a particular time of the year, as is usually known. While length of day is the primary external factor responsible for flowering, variations are chiefly due to the differences in temperature.

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April 16, 1951.

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AN ANTHRACNOSE DISEASE OF SPINACH

A SEVERE anthracnose disease of spinach (*Spinacia oleracea* L.) was observed in the Botanical Garden of Agricultural College, Kanpur, during 1947. A preliminary survey revealed that this disease also causes considerable damage to the crop in the neighbouring villages of Kanpur and other parts of Uttar Pradesh. It appears from the middle of January and gradually increases upto the harvesting season of the crop. The disease was first reported in 1890 by Ellis and Halsted¹ in New Jersey (New York) on spinach leaves and later by Petri,² Poeteren³ and Schultz⁴ on leaves, petioles and seeds. In India, this is the first record of the disease. The causal organism of the disease is *Colletotrichum spinaciae* Ell. and Halst. hitherto unrecorded from India.

The disease first appears on the leaves of spinach as minute, small, inconspicuous, yellowish, transparent spots which are usually circular, moist and water-soaked in appearance which later on become larger and develop a brownish rim. These lesions are about 2 to 4 mm. in diameter with slightly raised borders, but when two or more spots coalesce they become irregular in shape, the largest being an inch in diameter. Spots are generally seen at the margin of the leaf, being often elongated towards the midrib. The main nerves of the leaf limit the spread of the spot in certain directions. Then minute brown pustules appear upon either side of the leaf in five to seven days after the first indication of the blotch.

The symptoms on the stem appear at a later stage when the crown leaves have been removed giving rise to central shoot in plants left for seeds. The discolouration of the surface and the production of the water-soaked areas are the first indication of the disease on the stem near or above the ground level. Reddish brown areas are also formed which become dark brown as the disease advances. The central portion of the spot turns ashy white and shows the presence of acervuli.

The floral axis does not develop typical symptoms. The seeds are thickly covered with acervuli and become slightly black in appearance.

Usually the affected portions dry up and are studded with numerous dark dot-like acervuli which later on project outwards and become more prominent and slightly shrivelled. The disease, being of destructive nature, spreads rapidly from plant to plant of various ages, forming patches on all parts of the plant except the roots; ultimately resulting in the death of the plant.

Microscopic examination of the spots shows the presence of colourless, septate, branched hyphae. These are both inter and intracellular and ramify within the host tissues. Hyphae become shining brown at a later stage and measure from 1.6-4.6 μ with an average of 3.1 μ . Afterwards the mycelium collects into an entangled mass of hyphae below the surface of the cuticle. Due to the development of stroma, the cuticle is ruptured and the acervuli bearing conidia, conidiophores, and setae become visible on the surface. The colour of the acervuli is dark brown and changes to black. These are seen on the surface of the infected portions of the plant as small black dot like structures by the naked eye. When mature they are circular or oval, varying greatly in diameter and measure from 69-162 \times 54-102.2 μ .

Setæ or bristles are long, dark brown, thick walled, septate, unbranched, tapering towards the end and broader at the base. The tips are lighter in colour than the rest of the setæ. They measure from $54.4-154 \times 3.6-6.6 \mu$. Conidiophores are short, colourless, hyaline, continuous, are short, colourless, hyaline, continuous, simple, erect and are in crowded layers. These are single-celled, unbranched, packed together, broader at the base and tapering, slightly rounded at the tip. They measure $13.2-23.1 \times 1.8-3.5 \mu$. Conidia are hyaline, but appear slimy whitish pink in mass and are borne singly at the end of the conidiophores or may fall off. They are single-celled, sickle shaped (curved) and are filled with thick granulated protoplasm in the younger stage. Later they contain two or three oil globules and measure $13.2-28.8 \times 2.8-4.2 \mu$. The chlamydospores and appressoria have been observed in artificial cultures. Chlamydospore may be completely round or elongated, surrounded by a thick membrane and measure $6.48-21.6 \mu$ in diameter with an average of 13.8μ . Appressoria are slightly round or pear shaped varying in shape and size.

The pathogenicity of the isolates has been tested by various inoculation experiments under artificial and natural conditions and the fungus proved to be pathogenic. Symptoms identical to those caused by *Colletotrichum spinaciæ* on spinach are produced after six to ten days. Re-isolations from these artificially inoculated diseased materials produced cultures identical to the original ones.

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AUTOCATALYTIC CURVE DURING NITRITE FORMATION

It is well known that during nitrification, the graph of nitrate accumulation against time follows an 'S'-shaped path, characteristic of many physiological processes. This was first demonstrated by Lees and Quastel² by means of their soil-perfusion technique. Later, Martin³ using the value of K was able to classify some grassland soils. These investigations indirectly

favoured the biochemical theory of soil nitrification.

Since nitrite formation is part of nitrification and as such curves had not been demonstrated previously in tropical soils, we set out to plot the values of *Nitrite accumulation* against time, of two local soils. Secondly, it was also attempted to find out if the value of K, as judged from above, could enable us to arrive at some conclusions regarding 'soil fertility'.

Soils were selected from the roots of two plant associations, namely, *Amaranthus spinosus* which indicates a high nitrifying capacity, together with a high degree of nitrophily,¹ and *Eleusine indica* showing low nitrifying capacity and growing in unfertile habitat.⁴

These soils were distributed in a set of 20 flasks, each of which contained 20 c.c. of sterilised Omeliansky's culture solution with 1 c.c. of 5% ammonium sulphate solution. The temperature, light (the experiments were performed in the dark), and relative amount of soil to solution were the same for both the soils. The nitrite-nitrogen obtained during the process was measured as p.p.m. by the Griess-Llosway colorimetric method.

When the values for nitrite accumulation were plotted against time, an almost perfect 'S'-shaped curve was obtained which, unlike the nitrate curve² precipitated swiftly downwards after achieving the peak. This is due to rapid transformation of nitrite-nitrogen to nitrate-nitrogen after a certain 'threshold' value.

The equation for the curve as given by Quastel² is:

$$\log y/(A-y) = K(t-t_m),$$

where y is the amount of nitrite accumulated in time t ; A the initial quantity of nitrogen subjected to transformation and K the "Rate Constant"; t_m is the time taken for half completion of the process and represents the point when the rate of conversion of ammonia is the fastest.

In the present experiment, the value of A has been taken as equal to the maximum value of y during the process. In case of *Amaranthus* soil, the value of A has exceeded the theoretical value (530 p.p.m. of nitrogen as calculated from the amount of ammonical nitrogen initially supplied); the excess of nitrogen found over that added must have arisen from the nitrification of soil ammonia.³ From the day-to-day values of nitrite-nitrogen, the graph of $\log y/(A-y)$ against time t was also plotted which gave straight lines for both the soils. (Fig. 2).

The following table shows the results given by the two soils:

(i) <i>Amaranthus spinosus</i> soil			(ii) <i>Eleusine indica</i> soil		
Time in days 't'	Accumulated Nitrite N in p.p.m.	$\log \frac{y}{A-y}$	Time in days 't'	Accumulated Nitrite N in p.p.m.	$\log \frac{y}{A-y}$
2	15	-1.55	6	55	-0.93
4	56	-0.95	11	125	-0.52
7	100	-0.65	14	220	-0.15
9	198	-0.25	17	310	+0.15
12	380	+0.35	19	400	+0.49
14	500	+1.0	21	460	+0.72
16	550	..	23	480	+0.98
18	410	..	26	505	..
21	Nil	..	28	295	..
			30	Nil	..

From these results, graphs showing the accumulated nitrite-nitrogen against time (Fig. 1), and

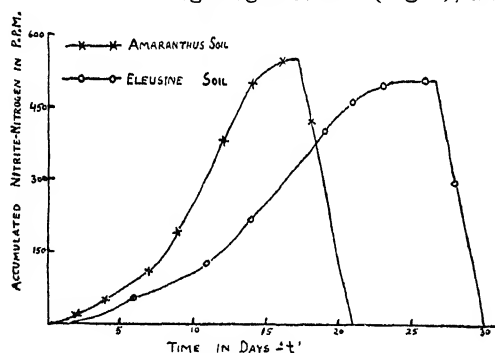


FIG. 1

the regression of $\log y/(A-y)$ on t are plotted. From the slopes of the straight lines obtained in Fig. 2, the rate constant, K , is calculated for the two soils.

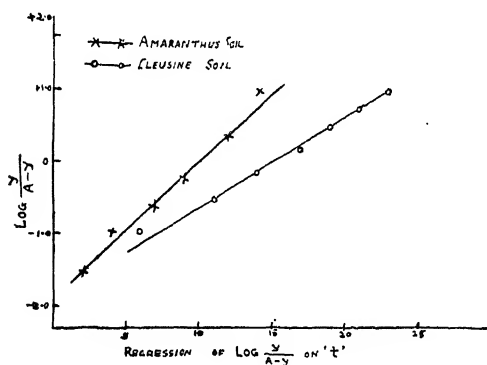


FIG. 2

K for *Amaranthus spinosus* soil = 0.193.

K for *Eleusine indica* soil = 0.125.

From Fig. 1, it can be seen that the oxidation of ammonia to nitrites follows a typical 'S'-shaped curve as the regression on time also gives a straight line (Fig. 2). It could be seen from the graphs that the curve for the fertile soil (*Amaranthus*) shows a steeper course and requires a shorter duration to reach the peak than the infertile soil from *Eleusine*, and hence the oxidation in the former is faster than in the latter. The rate constants, K , also vary with the nature of the soil, i.e., in the fertile soil the oxidation of ammonia being speedier, the value of K is higher than in the fallow unfertile soil. Hence, on the basis of the differences in the "rate constants", we are able to grade the various types of soils.

Thus, our investigations have shown that the oxidation of ammonia to nitrites also shows the "autocatalytic curve" which indirectly proves the biological nature of oxidation.

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May 1, 1951.

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A NOTE ON THE OCCURRENCE OF *TRIPHLEPS* SP. (ANTHOCORIDAE— RHYNCHOTA), A HITHERTO UNRE- CORDED PREDATOR OF STORED GRAIN PESTS IN INDIA

DURING the course of investigations on the biology and control of stored grain pest, the writer found several Anthocorid bugs in cultures of *Latheticusoryzæ*. The bug was identified by the Commonwealth Institute of Entomology, London, as *Triphleps* sp. It is a predator on stored pests and has been recorded for the first time in India. There are records of only a couple or so of the species of *Triphleps* in stored grains in the world. One of them, viz., *T. frumenti* is reported as "possibly predator on pests of imported grains in Germany" and the other, viz., *T. madeirensis*¹ is reported in stored grains in Egypt. After comparing the descriptions of the predators mentioned above with the one found, it was observed that the present species differs markedly from the above two. The detailed studies on the biology of the predator has been completed at the Entomological Laboratory, I.A.R.I., New Delhi,

at room temperature during the months of March-April-May. The adult bug is dark brown or black in colour and measures about 1.7 to 2.2 mm. in length and about .7 to nearly 1 mm. in breadth. The wings are very short. There is a slight variation of size in the two sexes. The preoviposition period was found to be 2-4 days. The number of eggs laid varied from 2-9 eggs per female per day depending on the quantity of food available. The incubation period varied within 4-5 days. The 1st, 2nd, 3rd, 4th and 5th stages lasted for 2-4 days, 2-3 days, 2-4 days, 2-3 days and 3-5 days respectively. There are altogether 5 moults. The nymphs were found to predate at the rate of one grub a day. The adults though generally predated on one grub only were sometimes found to predate on two grubs on the same day. This was specially so in the case of *O. surinamensis* where even three younger grubs were fed upon in one day. The mode of feeding was also studied. The nymphs, specially the younger ones, prefer younger grubs of the hosts. The bug was found also to predate on the grubs that had freshly pupated. It was also found to predate on younger stages of *Corcyra cephalonica* but preferred the grubs of *L. oryzae* and *O. surinamensis*.

There can be little doubt that the predator plays an important role in keeping down the pests infestation in the stored cereals. Further work is in progress.

Ind. Agric. Res. Inst., SNEHAMOY CHATTERJI.
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ADAPTATION OF FUNGI TO FUNGICIDES AND ITS SIGNIFICANCE IN AGRICULTURE

REFERRING to the adaptability of fungi to increasing concentrations of toxic substances, Stakman, Stevenson and Wilson³ stated that haploid lines of corn smut showed a definite increase in tolerance to arsenic in the media if they were grown on a series of ever increasing concentration of sodium arsenite. This tolerance or ability to grow in the presence of arsenic could be raised to a considerable degree over that of any line not having had such treatment. Gattani² showed that diploid lines of corn smut like their haploid parents developed the ability to grow on media containing approximately six times the concentration of sodium arsenite as the lines would tolerate initially. Christensen

showed that monoconidial isolate of *Giberella zeae* developed increased tolerance to malachite green, mercuric chloride and ethyl mercuric phosphate. From these investigations it would appear that if fungi could adapt themselves to increasing concentrations of toxic chemicals, our attempts to control plant disease by a given chemical agent would defeat its own purpose.

The author has been carrying out investigations since 1944 to find a solution to this problem. During the course of these, single spore isolations of *Alternaria* sp. associated with wheat seeds were made and the fungus grown on potato dextrose agar (PDA) containing increasing concentrations of Agrosan GN, (fungicide with an organic mercuric compound as the active ingredient). When the fungus was transferred directly from potato dextrose agar to PDA containing increasing concentrations of Agrosan GN, it could grow only on media containing upto 300 p.p.m. of Agrosan GN in PDA. From lower to higher concentration there was a gradual decrease in the size of the colony. However, on being successively transferred during five transfer generations from lower concentrations to higher concentrations of Agrosan GN, the fungus could be made to grow on PDA containing 700 p.p.m. of the fungicide.

Next the fungus was grown on potato dextrose agar containing different concentrations of Arasan. (50 per cent. Tetra methyl thiuram disulfide). The unadapted line could only grow on PDA containing upto 700 p.p.m. of Arasan. When the fungus was transferred successively during seven transfer generations from media containing lower concentrations to higher concentrations, it could grow on PDA containing 2,000 p.p.m. of Arasan.

The next phase of the investigation was to study the behaviour of the line adapted to Arasan on the media containing increasing concentrations of Agrosan GN and the line adapted to Agrosan GN on the media containing increasing concentrations of Arasan. It was observed that the line which had been adapted to Arasan, when transferred to the Agrosan GN series behaved like an unadapted line as it could tolerate a concentration of 300 p.p.m. of Agrosan GN only. In the same way the line which had been adapted to Agrosan GN when transferred to the Arasan series behaved like an unadapted line as it could grow on PDA containing upto 700 p.p.m. of Arasan only.

These investigations thus provide a clue to the problem of adaptation of fungi to fungicides. When plants are sprayed or dusted with fungicides it is possible that the fungus may be exposed to the fungicide for a considerable

period, and may, therefore, adapt itself to that particular fungicide. Continuous use of that fungicide may prove ineffective for control of that disease. In the light of these investigations the obvious remedy in such a case would be to use another fungicide containing a chemically different active ingredient as a dust or spray reagent.

Fuller details will be published elsewhere.

The author is grateful to Prof. E. C. Stakman of the University of Minnesota, U.S.A., for many helpful suggestions.

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June 16, 1951.

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RUSTS ON WILD GRASSES

DURING 1948-49 there was a severe outbreak of rusts on the wheat crop in the farm attached to the Botany Division of this Institute and it was observed that 13 out of 59 wild grasses that were being grown in the neighbourhood of wheat plots were infected with rusts. Yellow

lops *trinecilis*, infected wheat. Morphologically also all the collections were identical with black rust of wheat and so belong to *Puccinia graminis* var. *tritici*. Spores from *A. trinecilis* had lost their viability, so that no conclusions regarding the identity of this rust can at present be drawn. The relevant information regarding the grasses which were found infected is given in the table. The size of uredospores of black rust of wheat collected from the neighbouring plots is also provided for comparison.

Rusts from host Nos. 7, 9, 11 and 12 yielded races 21, 40 and 42 of *Puccinia graminis tritici*.

In view of the fact that black rust of wheat has been found to infect these grasses, all of which are exotics, it is very essential to test the reaction of the imported grasses to Indian physiologic races of wheat rusts under quarantine conditions prior to their release for general cultivation in this country, as these may act as collateral or alternative hosts of wheat rusts. Even annuals imported from temperate countries may be able to grow during summer in the hills and submontane regions where over-summering of rusts is frequent. Susceptible grasses, both annuals and perennials, would thus act as congenial alternative hosts for the multiplication of initial inoculum.

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Name of host

Source

Size of uredospores in μ

1	<i>Bromus coloratus</i>	Uruguay	23.3-36.6 × 13.3-16.6
2	<i>Bromus carinatus</i>	Uruguay	23.3-36.6 × 13.3-16.6
3	<i>Bromus mollis</i>	U.S.A.	21.6-33.3 × 11.6-18.3
4	<i>Hordeum distichum</i>	Baluchistan	23.3-33.3 × 13.3-16.6
5	<i>Hordeum murinum</i>	Baluchistan	23.3-33.3 × 13.3-16.6
6	<i>H. stenostachys</i>	Uruguay	23.3-33.3 × 13.3-16.6
7	<i>Agropyron semicostatum</i>	China	19.9-33.3 × 13.3-16.6
8	<i>Lolium perenne</i>	Australia and Quetta	19.9-33.3 × 11.6-16.6
9	<i>Hilaria Jamesii</i>	U.S.A.	19.9-36.6 × 11.6-16.6
10	<i>Aegilops squarrosa</i>	Kew	23.3-36.6 × 13.3-16.6
11	<i>A. ventricosa</i>	Kew	23.3-36.6 × 13.3-16.6
12	<i>A. trinecilis</i>	Kew	23.3-36.6 × 13.3-16.6
	Wheat (Local variety)		21.6-36.6 × 13.3-16.6

rust [*Puccinia glumarum* (Schm.) Erikss. & Henn.] was present only on *Phalaris minor*, whereas, all the rest were infected with black rust (*Puccinia graminis* Pers.). Yellow rust found on *Phalaris minor* failed to infect wheat and appears to belong to a different variety. Also, artificial inoculations of this grass with yellow rust from wheat were unsuccessful. Black rust found on other grasses, except *Aegi-*

BLACK MOULD OF ONIONS IN STORAGE CAUSED BY *ASPERGILLUS NIGER*

ONIONS are imported in large quantities into Bangalore from Rampur, Anantapur, Bellary and Gulbarga. The imported onions in storage frequently show black lines between the outermost dry scales, sometimes thin, sometimes

diffuse (see Fig.). These lines are in the region of the veins. On microscopic examination they are seen to consist of the conidiophores and conidia of a species of *Aspergillus* looking like *A. niger*. Mites are found feeding on the spores. Apart from the disease spreading by actual contact of sound with mouldy onions, the mites may serve to start the infection in a fresh consignment when it is stored in an infected godown. Hansen and Davey² have found that mites and thrips are responsible for transmission of *Aspergillus* spp. and other fungi in figs.



Black mould of Onions. Outer scale removed completely in 1 and partly in 2 to show the black lines.

Both the white and red varieties are attacked, the white being very susceptible. Ordinarily the damage in the godowns may be up to 5 per cent. of the bulbs, but under humid and ill-ventilated conditions it may reach 30 per cent. The rot is a dry one in the early stages, but later on, due to invasion of soft rot bacteria, a wet rot develops.

The fungus infection may start at the base of the bulb, and proceed to the neck, or may start at the neck and travel to the base.

The fungus was brought into pure culture by taking the spores aseptically on a platinum spatula, and planting them in a poured plate. Transfers from the edge of the resulting colonies gave a pure growth.

Inoculations were made in the laboratory using the white and red varieties of onions. Punctures were made on the bulbs with a sterile needle, small bits of a pure culture placed over the punctures, and the inoculated bulbs kept in a moist chamber. The white variety took the infection in two days, and was completely infected in a week to ten days. The infection on the red variety was confined to the points of inoculation and did not spread. The controls remained healthy. The fungus was re-

isolated from the inoculated onions, and was found to agree with the original isolation.

Infection by *A. niger* on onions has not been recorded before this in India, although it has been observed in U.S.A.,^{4,5} Canada³ and Australia¹ *Aspergillus* spp. have been known to cause rots and moulds in figs, dates, pomegranates, apples, citrus fruits, cotton bolls and mangoes. The fungus is a weak pathogene and its effects are apparent under stored conditions.

Lab. of Plant Path., S. V. VENKATARAYAN.
Dept. of Agriculture, M. H. DELVI.
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OZONIUM WILT DISEASE OF POTATO

Root rot and wilting of potato plants incited by a soil-inhabiting fungus was observed in the Central Potato Research Institute, Patna, for the first time during the crop season of 1949-50. The disease was noticed again on the crop in the Institute in 1950-51. The affected plants first showed slight yellowing of the lower leaves, followed by sudden loss of turgidity and wilting of the entire plant within a few days. A brief survey has indicated that this disease may be widespread; it has so far been found to occur in the cultivators' crop in the Patna City and Bhowali (Uttar Pradesh) and in the crop at the Potato Breeding Sub-station at Simla. About one per cent. of the *Phulwa* plants in some cultivators' fields at Patna and up to three per cent. of the plants in the variety *Majestic* in restricted plots at Bhowali wilted due to infection by this fungus.

Examination of the underground portions of the diseased plants showed the presence of a delicate net work of rhizomorphs of the fungus branching fan-wise (Fig. 1). The stolons and roots were killed at first by the fungus which gradually spread and girdled the stem at the collar region. At this stage, the plant showed sudden wilting due to failure of translocation of water to the shoots above-ground. On the rhizomorphs, numerous orange-buff to brown sclerotia which were smooth, ovate to spherical in shape and measuring 1 to 3 mm. in diameter, were borne.

The fungus grows readily on artificial media developing strands of hyphae and numerous



FIG. 1. Showing the rhizomorph and the sclerotia produced on the plant $\times 1$, Nat. Size.

sclerotia which are larger in size and variable in shape than those produced on the plant (Fig. 2). Inoculation experiments using fungal strands and sclerotia produced in artificial cultures, brought about the wilting of potato plants (Darjeeling Red Round) within 20 days.

Comparative studies have indicated that the fungus is a species of *Ozonium* closely resembling *O. texanum* described by Neal¹ and Wester, as being saprophytic on dead cotton stalks and roots in Texas (U.S.A.). The species under study has the potentialities of a serious pathogen similar to *Phymatotrichum* (*Ozonium*) *omnivorum* (Shear) Duggar in inciting the wilting disease of several other hosts (Streets),² such as tomato, sun-hemp, etc., in addition to potato.

It is proposed to present the fungus under study as a new variety, with the name *Ozonium*

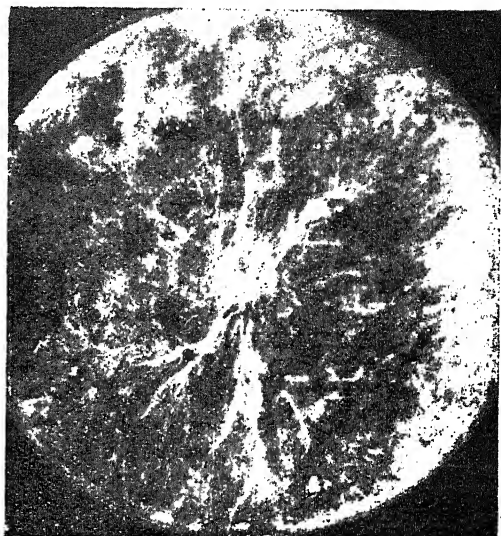


FIG. 2. Artificial culture of the fungus $\times 4$, Nat. Size.

texanum Neal & Wester var. *parasiticum*. The aetiology of the fungus, the extent of its distribution and the damage it causes to the potato crop are under investigation.

Grateful thanks are due to Dr. S. Ramanujam, Director, Central Potato Research Institute, for valuable suggestions.

Central Potato Research

Institute,

M. J. THIRUMALACHAR.

Patna (Bihar),

August 1, 1951.

1. Neal, D. C., and Wester, R. E., *Phytopathology*, 1934, **24**, 528-33. 2. Streets, R. B., *Univ. Arizona Tech. Bull.*, 1937, **71**, 299-410.

SECOND INTERNATIONAL CONGRESS OF BIOCHEMISTRY

THE SECOND INTERNATIONAL CONGRESS OF BIOCHEMISTRY is to be held in Paris from the 21st to the 27th of July, 1952.

The programme has not yet been definitely decided on. Nevertheless, the Congress Committee has drawn up a plan for the study of biochemical questions of current interest during seven symposia:

(1) Biochemistry of Steroids. (2) Biochemistry of Hæmatopoiesis. (3) Biogenesis of the Proteins. (4) Tricarboxylic Acid Cycles. (5) Bacterial Metabolism. (6) Mechanism of action

of the Antibiotics. (7) Protein Hormones and Hormones derived from Proteins.

Communications dealing with other biochemical problems will be grouped together in appropriate sections.

Four general lectures will be given by well-known scientists.

Authors should send the titles of their communications before the 1st of March, 1952, and a summary of less than 200 words before the 1st of April, 1952, to the General Secretary, Professor J. E. Courtois, 4, Avenue de l'Observatoire, Paris VI^e.

REVIEWS

Practical Mathematics, Part III. Geometry with applications. By Claude Irwin Palmer & Samuel Fletcher Bibb. (McGraw-Hill Book Co.), 1950. Pp. 200. Price \$2.20.

This book is the third in a series of four books in practical mathematics. It is intended for one who realizes that Mathematics is a powerful tool which he must be able to use in performing his work and who has no previous knowledge of the subject. The fruit of hundreds of years of labour in plane and solid geometry is presented in a simple and direct manner.

The subject is divided into nine chapters in the usual order and some of the chapters begin with interesting previews". The set of tables at the end of the book will be found very convenient and useful to all practical workers. Intuitive methods are used for establishing geometrical principles and facts.

The text deals with many applications under separate headings, such as brickwork, lumber, the steel square, screw threads, belt pulleys and gear wheels. Numerous interesting exercises representing up-to-date problems in various fields are included.

The book contains more than 200 beautiful diagrams. Printing and get-up are excellent. The book is written in a beautiful style and is sure to be a very useful handbook for a practical man.

S. N. M.

Basic Mathematical Analysis. By H. Glenn Ayre (Mc-Graw Hill Book Co.), 1950. Pp. 584. Price \$5.00.

As the title itself suggests, this book gives a descriptive and detailed exposition of the analysis of basic mathematics, beginning with the development of the number system, exponents and logarithms. These cover the first four chapters; the concept of functions, trigonometric functions and solution of triangles cover the next four chapters. Chapter Nine, where the notion of limit, and the derivative as measure of rate of change, are explained and Chapter Ten together cover approximately the Intermediate Syllabus in Differential Calculus of the Indian Universities. The remaining chapters deal with polynomial equations, conic sections, polar co-ordinates and "special curves", quadric surfaces, simple sequences and series and an introduction to the exponential function.

Every theoretical idea is illustrated graphically and interesting historical notes are inter-

spersed in the chapters. Some of the defects like that of introducing the exponential function as $(e)^x$ without mentioning anything about irrational exponents, are in glaring contrast with the systematic development in the earlier chapters. It would have been more pleasant reading if examples and explanations of too elementary a nature were omitted.

It is neither sufficient nor necessary as a text-book at any stage. The book serves its purpose best as an interesting and desirable reading for students of Mathematics in general, and to the First Year Honours students of our Universities in particular, inspiring them with a desire to explore the wonderful kingdom of "The Queen of Sciences" and enabling them to develop the proper background for the rigour of more advanced courses.

S. N. M.

Creep of Metals. By L. Rotherham. (Institute of Physics Monograph), 1951. Pp. 80. Price 15sh. net.

A balanced picture is first presented of the mathematical law relating creep rate to stress, temperature and time, with special reference to the classical work of Andrade. Next, the mechanism of crystalline flow is discussed and the discrepancy between the theoretical and observed critical shear stress is explained by the modified dislocation theory of Taylor. The mechanism of creep deformation as observed in single, bi-, and poly-crystals is developed and the divergent theories of "slipless" flow of Hanson & Wheeler, the "cell" division of crystal grains of Wilms and Wood and the "polygonisation" of Lacombe & Beaujard are stated cogently. The ideas of Orowan, Mott and Nabarro are analysed to account for transient creep due to presence of dislocations; steady-state or viscous creep is explained by a similar mechanism operating in the grain boundaries and the adjoining crystal regions. Experimental evidence is adduced to show the intercrystalline cracking that generally precedes the last or tertiary stage of creep.

The monograph carries the authority of many years of research at the R.A.E., Farnborough. It is eminently suitable for the use of research workers and metallurgists who already are well acquainted with the background of the subject. The matter and style are crisp and the

book has an excellent bibliography. The Institute of Physics is rendering a service to industry by bringing out such publications.

Climate Near the Ground. By Prof. Dr. Rudolf Geiger. (Harvard University Press, Cambridge, Massachusetts). (Translated into English from German by Milroy N. Stewart and others). Price Rs. 25.

Prof. Dr Rudolf Geiger is a world authority on the above subject. His classical book entitled *Das Klima der Bodennahen Luftschicht* has been revised twice and now a fourth edition is due. Meanwhile, here is an English translation of the second edition. Prof. Geiger's School of Micro-Climatology has been an inspiration to workers in this field for several decades now. The English version renders a most valuable service by making available to us the literature on this subject, which deals with the actual environment in which plant, animal as well as human communities live and grow.

The book is divided into 2 parts. The first part deals with the climate existing near the ground and is divided into 17 chapters. The complex subject of the heat balance near the ground which depends on various factors like solar radiation, albedo, radiative exchange in the infra-red region, conductive processes into the ground as well as convection upwards into the air through the medium of eddies and heat taken up for evaporation and that released during condensation of moisture; the special phenomena such as high lapse rates by day and strong inversions of temperature associated with nocturnal cooling, the diurnal variation of temperature and its variation with height; and humidity and wind relationships in which ground surface and air layers near the ground play an important part: all these are discussed in these several chapters in a most fascinating manner, leaving the reader with clear-cut and precise ideas on the subject at the end of even the most rapid perusal.

In Part II, Prof. Geiger deals with the effect of topography on the microclimate which profoundly influences the way in which the cold air manufactured by nocturnal radiation processes is redistributed very much like water collecting at the bottom of valleys. The influence of inclination of the ground to the vertical on the microclimate and the microclimates of caves and enclosed spaces are also dealt with. Later, we are led on in a logical manner to the influence of plant cover on microclimate. The way in which plant communities are influenced by climate and in turn influence the local climate, the effect of the various phytophases

on the variation of microclimate during the course of the year, etc., are also discussed. Chapters 36 to 41 deal with the relation of animate creatures and man to the microclimate, an important branch of bioclimatology. As mentioned already, the discussion throughout is based on fundamentals and the author spares no pains to show how simple the various complex phenomena really are and how every aspect of bioclimatology finds simple explanation on the basis of the fundamental laws of physics. During the last 20 years the author and the present reviewer have been in close contact with each other's work and it is indeed a pleasure to note that the work we have been developing in India on the subject of microclimatology finds very frequent reference in the course of the book which contains many reproductions of diagrams from the Indian publications. There is also a well arranged bibliography at the end of the book.

This most important publication of the year on climate of the air layers near the ground should make a very profound appeal to physicists, biologists, meteorologists, botanists and foresters as well as to those engaged in medical and house building research. We warmly recommend it to scientists in India. The price is modest and we hope a copy of it will soon be in the library of every research institute and university in India.

L. A. R.

The Growth of Physical Science. By Sir James Jeans. Second Edition. (Cambridge University Press), 1951. Pp. x + 358. Price 15 sh.

The second edition is practically the same as the first which came out in 1947, except that some corrections have been made regarding citations, dates and such minor details. Jeans has the rare gift of lucid exposition; combined with a careful selection of the material, the book has become an eminently readable account of the history of physical sciences. To the eager reader, there is sustained interest from beginning till end and this is further enhanced by the introduction of humorous anecdotes regarding the lives of the scientists.

Nearly a third of the book is devoted to the scientific achievements of Babylonia, Greece and Egypt, which is followed by a brief section about the so-called dark ages, leading upto the birth of the "renaissance". The rest of the book gives a bird's-eye-view of modern science, mainly through short biographical sketches of the prominent men of science in each era.

Thus the book essentially deals with the progress of science in Europe and the Middle East.

As Jeans himself says, "India and China contributed to Western science only through the intermediary of the near east, so that we shall not go far wrong if we disregard these remoter Eastern civilizations and confine our attention to the nearer which formed direct stepping-stones into Europe." However, he does touch upon the contributions of these countries in exceptional cases, e.g., he says, "the Indian mathematician Bhaskara (born in 1114), wrote an astronomy which contains the first known explanation of our present-day method of addition, subtraction, multiplication and division."

The book is moderately priced and the printing and get-up are excellent. It should find a place in every library, both scientific as well as non-scientific.

Fourier Transforms. By I. N. Sneddon, (McGraw Hill Book Co.), 1951. Pp. 542.

This book, which forms the third in the International Series of Pure and Applied Mathematics, does justice to the title of the series in that it deals adequately with both purely mathematical aspects of Fourier transforms as well as their applications to mechanics and physics. It is intended for those who have had a fairly good grounding in mathematics, but no specialised knowledge of any branch of physics is assumed. The first three chapters deal with the basic mathematical theorems in Fourier transform theory. Unlike some other books in this field, which restrict themselves to a special type of transform, such as the Laplace or the Mellin transform, here the whole field is briefly surveyed—Fourier's integral theorem, Laplace transform, Mellin transform, Hankel transforms and finite transforms, both of the Fourier and Hankel types. These chapters are written in such a manner that a student not interested in the details of the proofs may readily pick up the results he needs.

The rest of the book of nearly 450 pages, contain details of the numerous applications of theory and it is in this that the book under review makes a notable departure from the conventional mathematical treatises. The examples chosen are not just those which nicely illustrate points of theory, but rather those which one practically meets with and in which the theoretical method has to be suitably modified. Most of the examples are taken from research papers written in the last ten years. They cover a wide field—theory of vibrations, conduction of heat, two-dimensional and axially symmetrical stress distributions, hydrodynamics, atomic and nuclear physics and the slowing down of neutrons in matter, for which the

equations closely resemble those of heat conduction.

The book would be best appreciated by research workers, rather by those who are starting on research, as it very ably expounds the technique of working out various problems.

G. N. R.

Chemical Activities of Fungi. By Jackson W. Forster. (Academic Press Inc., New York), 1949. Pp. xviii + 648. Price \$9.50.

The subject of fungi, first developed by mycologists as a part of systematic and morphological botany, attained chemical and physiological significance when it was discovered that some of them cause disease among animals and plants while others could produce a bewildering variety of chemicals—acids, solvents, vitamins, enzymes and antibiotics. The successful production of some of these chemicals on an industrial scale has greatly stimulated a further systematic and intensive study of the metabolism of these widely distributed and industrially important organisms.

When the distinguished author commenced his graduate apprenticeship in 1936 under the inspiring guidance of Professor Waksman, he was bewildered at the "unavailability of a suitable treatise comprehensive enough to orientate a non-specialist in this field." Although a tremendous amount of useful and suggestive work had already been carried out it was, at the time, found widely scattered in scientific literature. The author felt the need for "an authoritative, critical book, integrating and evaluating the field" and "was presumptuous enough to tell Dr. Waksman that he ought to write such a volume". Dr. Waksman's counter-suggestion that he should work for 5 years and write it himself, has apparently inspired the production of this excellent treatise on the Chemical Activities of Fungi.

In a series of 19 chapters, the author has broadly covered the field of fungal biochemistry both in its academic and technological aspects. The second chapter on the methodology of mold metabolism will be found extremely useful to every worker in biochemistry seeking guidance on the technique of handling molds for research. The fifth chapter on natural variations deals with an important aspect of fungi which reminds the uninitiated investigator about the instability, mutability and the "treacherous" character of these organisms.

Improvement of strains of industrially important fungi through artificially induced mutations to day constitutes an accepted method of enhancing or side-tracking or controlling the

chemical activities of fungi, and of raising the yield of their products to economically competitive levels. Penicillin production owes its spectacular success to the development of high yielding mutants of *Penicillium chrysogenum*. The technique of inducing such mutations and the genetic and the biochemical mechanisms operative in such mutants, are described in the sixth chapter.

The seventh chapter is concerned with the trace elements which profoundly influence the course of biochemical reactions in fungi. The succeeding chapter deals with the formation and metabolism of alcohol and some important di- and tri-carboxylic acids. Itaconic acid which has attained great significance in industry on account of its employment in the production of methacrylic acid has received special attention (Chapter 13). The last chapter is devoted to the microbiological aspects of penicillin which contains a revealing and historical account of its development in the United States. In this review, it has been possible for us to invite attention to only a few of the important highlights of this volume which will be gratefully welcomed by all investigators interested in the fields of Comparative Biochemistry and Fermentation Technology.

Technique of Organic Chemistry. Vol. V. Adsorption and Chromatography. By H. G. Cassidy. (Interscience Publishers, New York), 1951. Pp. xix + 360. Price \$ 7.00.

The first book on the Principles and Practice of Chromatography (Zechmeister and Cholonky) appeared in 1941, followed a year later by Strain's book on Chromatographic Adsorption Analysis. The papers published on chromatography during the last ten years run into many hundreds, and since 1949 Strain has been making an annual review of chromatography in Analytical Chemistry. The New York Academy of Sciences, the Faraday Society and the Biochemical Society have held symposia on the subject. However, this book represents the first attempt "to describe and explain, by discussion of principles, the various methods by which adsorption may be utilized in organic chemistry as a tool for the separation of mixtures."

Since theoretical treatments of chromatographic analysis are mainly based on adsorption isotherms, it is appropriate that an account of chromatography should be preceded by a treatment of adsorption. To those primarily interested in the use of chromatography for solving problems of separation, and because the book is a volume in a series on *Technique of Organic Chemistry*, it may appear that the methods

and theory of batchwise adsorption, treated extensively in books dealing with surface phenomena, have occupied a disproportionate amount of space. After a careful study of the book, there will be general agreement that a full understanding of the nature of adsorption and adsorbability greatly facilitates an understanding of the principles of chromatography in all its aspects.

The first four chapters cover the molecular aspects of adsorption, measurement of adsorption and treatment of the data, relations between adsorbability and properties of phases, and relations between relative extent of adsorption and properties of adsorptives. Adsorption in relation to molecular weight and melting point has not received adequate attention; better examples than toluene and acetic acid could have been cited to illustrate the dependence of adsorption on molecular weight. Chapter V summarizes these relations, and discusses the gradation of eluents and adsorbents. Chapters VI and VII on batchwise adsorption and decolorization are followed by three chapters on chromatography, classified conventionally as adsorption, ion-exchange and partition chromatography. The theory of each method is explained very clearly; apparatus, materials and manipulations are described; some applications of chromatography are mentioned and numerous references are given to books, reviews and papers from which details of specific applications can be obtained. Correlations between adsorption and chemical structure are considered in Chapter IV, but the chapters on chromatography do not include a discussion of the relation between the chemical constitution of organic compounds and their chromatographic adsorbability. It is curious that the word "carotenoids" does not occur in the index of a book on chromatography.

This book is the best available account of the basic principles of adsorption and chromatography, and is indispensable to every chemist.

K. V.

Flour Milling Processes. By J. H. Scott. (Chapman & Hall Ltd., London), 1951. Pp. 690. Second Edition. Revised. Price 55 s. net.

Striking improvements have been made in recent years in appearance and detail of milling machinery though the functional design has undergone little change. Flour milling research has received first-rate attention at the hands of flour millers, engineers and nutritionists. Introduction of automatic controls, pneumatic materials handling and fire prevention methods are important forward steps in milling industry.

This book deals with modern aspects of flour milling process in a very comprehensive manner. In Part I of the book various operations to which normally wheat is subjected before being milled are adequately discussed giving a brief description of the machines used. The physico-chemical and milling aspects of wheat conditioning have been discussed. Significance of Bushel Weight to millers is described and various factors modifying the bushel weight of clean wheat are discussed.

Part II of the book deals with the 'gradual reduction' milling system commonly used throughout Britain, and contains valuable information, both theoretical and practical, on various aspects of milling. The working of Break Rolls, Plansifters, Centrifugals, Purifiers and Reduction Rolls is discussed in great detail. Physical and chemical characteristics of various mill flours are given. Informative and highly useful chapters on mill exhaust, power, flour bleaching and insect infestation and control have been included. The book contains an appendix giving useful engineering data on milling machinery.

The author has indicated possible trends of future developments in milling and has ventured to give his ideas of a Flour Mill of the future. The book is strongly recommended to students of flour milling and to practical flour millers.

D. S. BHATTIA.

A Text-Book of Plant Pathology. By Edgar F. Vestal. (Kitabistan, Allahabad), 1950 (appeared in July, 1951). Pp. xxi + 645. Price Rs. 19-12-0.

When Dr. Vestal came to India to teach Plant Pathology at the Allahabad Agricultural Institute over 10 years ago, he became painfully aware of the lack of a suitable text-book. Butler's *Fungi and Disease in Plants* was out of print and information on Indian plant diseases was not easily available. A compilation of "Notes on Plant Pathology" was therefore a necessary corollary. The first set of "notes" was printed in 1941 and a revised version appeared in 1946. Before leaving India he decided to publish the "notes" in the form of a "text-book."

An introduction of 11 pages is followed by 14 chapters of which the first five are devoted to fundamental topics like fungi causing plant diseases, their classification, dissemination of plant diseases, methods of plant disease control, etc. The rest of the chapters deal with the more important plant diseases found in Northern India.

A cursory reading of the book has amazed the reviewer of the spelling mistakes, errors

of grammar and of facts. This book should not have been published or be placed in the hands of students, research or extension workers.

Only a few spelling mistakes can be pointed out here. "Burrell" for Burrill, "doddar" for dodder, "conoidiphorese" for conidiophore (p. 11), "Oomceies" for Oomycetes (p. 40), "Stagnospora" for *Stagonospora* (p. 72), "Keshwala" for Kheshwala, "Sclerotia" for *Sclerotinia* (p. 150). While such mechanical errors can perhaps be excused, it is difficult to gloss over errors of fact. Botanists will be amazed at the statement that Bentham and Hooker published *Floral Studies in India* (p. xii). The *Phycomycetes* are stated to be often referred to as the downy mildews (p. 7). This is a very serious mistake because only some genera of one family of this class are known by that name. We are told (p. 11) that antheridia and oogonia "are developed on semi-sclerotial masses of mycelium". The basidium (p. 15) is stated to be "mycelium produced when resting spore germinates." According to the author (p. 24) the reproductive stage of the *Fungi Imperfecti* is the vegetative stage. Apparently he means the asexual stage. The antheridium (p. 41) is referred to as a gamete; apparently the author means a gametangium. *Tilletiaceae* are stated to consist of two genera (p. 68) but three are described. The author (p. 70) states that in the class *Fungi Imperfecti*, "the perfect stage is not known or if known, it has been only recently discovered and the fungus has been listed among the *Fungi Imperfecti* for so long that it has been widely published in literature in that group and it is retained among them for simplicity." The meaning of this sentence is not clear.

All the names and synonyms of the species causing the bunt of wheat are given (p. 173). It would have been better if the author had given the accepted name of the organism. The "Karnal" or "partial bunt" of wheat is stated to be due to *Tilletia indica* and the name *Neovossia indica* is rejected for reasons which are not clear by a perusal of the account given in this "text-book." In a book published in 1950, it is amazing to read the statement "the life-cycle and mode of infection are essentially the same as for the other bunts of wheat". The author is apparently completely unaware that the disease has been shown to be not seed-borne; even the control measure which he recommends (p. 177) is absolutely misleading.

The author has described the "Take-all" disease of wheat (pp. 190-91) which is surprising; for it does not occur anywhere in northern or in any part of India, excepting in the writer's "text-book." He is confused about the causal

organisms of some of the diseases, especially the downy mildew; the loose-smut of jowar is stated to be due to *Sphacelotheca sorghi* and the grain smut to *Sphacelotheca cruenta*, whereas the case is otherwise. The name of the causal organism of the long smut of sorghum has been left delightfully vague. The reviewer came to know for the first time that *Verticillium* wilt of potato occurs in India. The fact is until 1950, no species of the genus *Verticillium* had been recorded for India and the one recorded is not on the potato. In his description of bunt of rice (p. 340), the author does not apparently know the change in the name of the casual organism and the method of transmission of the disease; the control measure he has given is totally unsuitable.

It is understood that an "Errata list" is in preparation but the only solution which the reviewer would like to suggest is that this edition should be, in the interest of all concerned, immediately withdrawn and a new revised edition published.

B. B. MUNDKUR.

Intermediate Practical Chemistry. By Sylvanus J. Smith. (Published by MacMillan & Co.), 1951. Pp. vii+248. Price 8sh. net.

Of its five sections, the first deals with quantitative analysis. The brief discussion on the theory of indicators is interesting. Precipitation methods involved in volumetric analysis is dealt in detail using the estimation of halogen ions, with a clear explanation of adsorption indicators. Numerous oxidation reduction reactions have been considered with due attention. The section includes an interesting discussion on the use of alkaline potassium permanganate solution in the estimation of formic acid. Iodimetry is discussed in detail. The use of titanous sulphate and ceric sulphate is also included.

The second section deals in detail with the various techniques involved in Gravimetric analysis. The use of organic reagents in inorganic analysis is mentioned briefly. A note on colorimetric method is also included.

In the section on 'Physico-chemical measurements', a limited number of experiments have been described and the treatment is not exhaustive, particularly from the view-point of advanced students.

The fourth section deals with organic preparations and the preparations considered are up to the standards of Hons. course.

An exhaustive treatment of systematic qualitative analysis together with the theoretical background forms the last section of the book. Methods of analysis, dry tests and spot tests

form an interesting portion of this section. Group separation is treated in detail.

Experiments described in the book are for B.Sc. and B.Sc. Hons. course of our Universities. The printing is very pleasing. The book is edited with much care and the get-up is very attractive.

K. S. SESHADRI.

CWIN Research Station, Poona: Annual Report (Technical), 1948.

A perusal of the Report of the Central Water Power Irrigation, and Navigation Research Station for the year 1948 convincingly proves, if proof is necessary, of the importance of hydraulic research in the development of river resources in the country. The high standard of work for which it is justly famous has been maintained.

Notable among the experiments carried out during the year were those pertaining to the improvement of the navigability of the Hoogly estuary, the Cochin Harbour, the training of the Ganga River at Garmukteswar, the Tapti at Surat, the Khipra at Ujjain and the Kuakhai at Bhuvaneswar. Experiments have also been carried out on spillways, dams and appertinant works.

Every experiment has been done with great care and the reports contain all the data necessary for proper appreciation of the results obtained. The get-up and printing of the book could be improved.

N. S. GOVINDA RAO.

Books Received

Fats and Oils (Industrial Oil and Fat Products). By Alton E. Baily. 2nd Edition. Interscience Publishers Inc., 1951. Pp. 967. Price \$15.00.

Six-Membered Heterocyclic Nitrogen Compounds with four Condensed Rings. By C. F. H. Allen. Interscience Publishers Inc., 1951. Pp. 345. Price \$10.00.

Chemistry of Muscular Contraction. By A. Szent Gyorgyi. Academic Press Inc., 1951. Pp. 162. Price \$4.50.

A Laboratory Manual of Qualitative Organic Analysis. By A. T. Openshaw. Cambridge University Press, 1951. Pp. 95. Price 8 sh. 6 d.

Die Chemische Affinität. By Egon Wiberg. Messrs. Walter De Gruyter & Co., Berlin W 35, 1951. Pp. 254. Price 40 Marks.

The Interpretation of X-Ray Diffraction Photographs. By N. F. M. Henry, H. Lipson and W. A. Wooster. Macmillan & Co., 1951. Pp. 258. Price 42 sh.

Fundamentals of Automatic Control. By G. H. Farrington. Chapman & Hall, 1951. Pp. 285. Price 30 sh.

SCIENCE NOTES AND NEWS

Geuns Helicoceras Linder

Sri S. Y. Padmanabhan, Mycologist, Central Rice Research Institute, Cuttack, writes as follows:

Sri. Daya Nand Pant, in a communication published in *Current Science*, Vol. 20, No. 8, August 1951, p. 212, claims to have recorded the Genus *Helicoceras* Linder for the first time in India. Attention may be drawn in this connection to the *Annual Report of Central Rice Research Institute*, 1948-49, p. 26, wherein *Helicoceras nymphaearum* (Rand.) Linder was reported to have been isolated from rice grains. The identification of the fungus was confirmed by Dr. Hughes of the Commonwealth Mycological Institute, England.

Food Plants of the Desert Locust

Referring to Sri. K. B. Lal's letter on *Food Plants of the Desert Locust*,* Sri N. N. Sen, Conservator of Forests, Land Management Circle, U.P., writes as follows:—

"It would be interesting to note that when some locusts settled down in June 1951, in Kukurail Forest Block, near Lucknow, they went selectively for the babul (*Acacia arabica*) trees only and did not touch any other species. There were a number of mango (*Mangifera indica*), mahwa (*Bassia latifolia*), neem (*Azadirachta indica*), reonj (*Acacia leucophlaea*) and cheonkar (*Prosopis spicigera*) and other species in the immediate neighbourhood.

* *Curr. Sci.*, 1951, 20, p. 165.

Control of the Indian Bookworm

The following recommendations are made regarding the control of infection of the larvæ of the bookworm, *Gastrallus indicus*:

The infected material should be air-heated in small lots, in suitable ovens at 60° C. for 4 hours or at 70° C. for 3 hours. Higher temperatures are not recommended as they would adversely affect the durability of paper, palm-leaves, etc. But should such an adverse effect be of no consequence (as in the case of the library cards), exposures to higher temperatures may also be made.—(By courtesy of the *Indian Forester*, 1951, 77, 511).

Technetium in the Sun

C. E. Moore (*Science*, 1951, 114, 59), has pointed out that spectral evidence suggests the existence in the Sun of the recently discovered element, 43, technetium. Comparing the wavelengths of the intense low level lines in the laboratory spectra of Tc I and Tc II with those of the lines in the solar spectrum, none are found corresponding to Tc I, either due to the lines falling on top of those due to other elements, or occurring in a region where they are masked by the continuum. In Tc II also, some of the lines coincide with those due to other elements, but the hitherto unidentified solar line at 3195.23 Å agrees well with the line at 3195.21 Å in the laboratory spectrum. None of the lines appear to be definitely absent, so that if technetium exists in nature, the above evidence would indicate the possibility of its presence in the Sun.

Nuffield Foundation Travelling Fellowships, 1952-53

It has been decided to award the Fellowships for the year 1952-53 in the following subjects:—

Two Fellowships in Medical Sciences, preference being given to candidates wishing to study (1) Pharmacology, and (2) Industrial Medicine; one Fellowship in Engineering, preference being given to candidates wishing to study Hydraulic Engineering or Agricultural Engineering; one Fellowship in Natural Sciences, preference being given to candidates wishing to study Industrial Standardisation and Quality Control. It is estimated that the total value of an award (exclusive of travelling expenses) will be at the rate of from £ 770 to £ 890 a year, according to individual circumstances.

Applications for Fellowships for 1952-53 (one original and three copies) should be submitted not later than 15th January, 1952, to the Secretary, Nuffield Foundation Indian Advisory Committee, Planning Commission, Government House, New Delhi, from whom copies of the form of application may be obtained.

Dye Extracts from Tamarind Seed Testa

Recent investigations carried out at the Forest Research Institute, Dehra Dun, have resulted in the development of a process by which it is

possible to obtain dye extract at a cost of about 9½ annas per pound from tamarind seed testa. The process in question has been patented and full rights of ownership therein now vest in the Central Government.

According to this process, the dye can be extracted from the testa in a standard form which has been found to give uniform and dependable results in dyeing and which in cost of dyeing compares favourably with the coal-tar acid dyes.

Any person or firm desirous of undertaking the exploitation of the process is requested to communicate direct with the Secretary, Patents Advisory Committee, Ministry of Commerce and Industry, Government of India, New Delhi, for further information.

Inventory of Research Equipment

Following the suggestions from a number of research workers, three types of data forms were prepared by the UNESCO South Asia Science Co-operation Office, New Delhi, and sent out to the Heads of the University Departments and research institutions to furnish information on the special apparatus, rare chemical and type cultures, etc., which they consider unique acquisitions in the laboratories. The value of the proposed inventory will be gauged by the information available which may help another institution to plan its laboratory equipment or to plan any research work. Very soon the collected information will be compiled and it will be appreciated if those who could not send the information earlier will kindly do so now.

Dr. K. R. Ramanathan

Dr. K. R. Ramanathan, Director of Physical Research, Ahmedabad, has been elected President of the International Association of Meteorology for the triennium, 1951-54.

Dr. B. R. Nijhavan

Dr. B. R. Nijhavan, Assistant Director, National Metallurgical Laboratory, Jamshedpur, has been elected a Fellow of the Institution of Metallurgists, United Kingdom.

Industrial Plants from Germany

India's war reparations from Germany include a Methanol Plant, a T.N.T. Factory, a Glycerine Plant, a Precision Machine Tools Manufacturing Factory and an Electric Steel

Smelting Furnace. The Methanol Plant from the Badische Anilin Soda Fabrik, Ludwigshafen, is valued at Rs. 5,30,282. It is meant for the production of methanol from the stage of compression of raw methane gas to a synthesis of 90 tons of pure methanol in 24 hours. It is expected that the plant will be taken up by the Sindri Fertilizer Factory.

Valued at Rs. 1,74,888, the Trinitrotoluene (T.N.T.) Factory is capable of producing 12 tons T.N.T. in 24 hours at the rate of 4 tons per charge and 3 charges per day. This plant has been retained for use by the Ordnance Factories.

European Brewery Convention

At a meeting of the Council of the European Brewery Convention, it was decided to hold the next Congress in the south of France, the subjects for discussion being: (1) the relation between the analytical figures of the barley and the malt and the physicochemical stability of the beer, and (2) the control of spoilage organisms in beer.

To facilitate the exchange of brewing students between different countries, each country was asked to prepare a list of breweries willing to accept such students.

Indian Association for the Cultivation of Science

At the Annual General Meeting of the Association held recently, the following Office-bearers were elected for the year 1951-52:—

President: Dr. J. C. Ghosh; *Vice-Presidents:* Dr. D. M. Bose and Prof. M. N. Saha; *Hony. Director:* Prof. P. Ray (*Ex-Officio*); *Members:* Dr. S. K. Banerji, Hon'ble Sri. C. C. Biswas, Dr. K. Biswas, Dr. S. R. Bose, Dr. P. N. Brahmachari, Sri Dwijesh Chandra Chakraborty, Dr. Satish Chandra Ganguly, Dr. M. S. Krishnan, Prof. P. C. Mahanti, Dr. Shyamaprasad Mookerjee and Sri Nagendra Nath Sen.

The Electrochemical Society: India Section

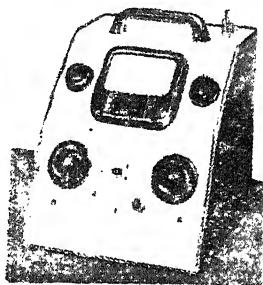
At the First Annual Meeting of the India Section of the Electrochemical Society held at Bangalore on August 2, 1951, the following Officers were elected:—

Chairman: Dr. B. K. Ram Prasad (Bombay), *Vice-Chairmen:* Mr. J. Balachandra (Bangalore) and Mr. K. Rajagopal (Mettur Dam), *Secretary-Treasurer:* Dr. T. L. Rama Char (Bangalore).

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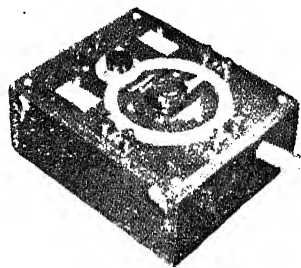
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KODAIKANAL OBSERVATORY (1901—1951)

NEARLY as old as most of the important modern astro-physical observatories of Europe and America, the Kodaikanal Observatory began systematic astro-physical observations in 1901, completing 50 years in March last.

The Observatory started with comparatively simple instrumental equipment such as was in vogue at the beginning of the 20th century. The more important astronomical equipment now in use consists of two spectro-heliographs, a prominence spectroscope, a photoheliograph, a spectrohelioscope, several powerful spectrographs and siderostats and a number of small and moderate-sized telescopes for general astronomical purposes.

Although Kodaikanal specialises in the study of the physics of the sun, it has made contributions to the study of planets, comets and stars as well. By reason of its important researches and of its peculiarly advantageous topographical and geographical position (nearly 7,700 feet above sea level) and its favourable climatic conditions, it is regarded as one of the foremost solar observatories of the world.

Under the auspices of the International Astronomical Union, it co-operates with other important observatories, such as those at Paris, Greenwich, Mount Wilson and Cambridge. It is responsible for the co-ordination of all obser-

vations on solar prominences and dark markings.

This Observatory made its mark early by the discovery of the radial motion in sunspots. Universally known as the Evershed-effect, this phenomenon has been the subject of prolonged study in this as well as in other astro-physical observatories of Europe and America. The observations of the spectra of Venus, Sirius and Nova-Aquilæ carried out at Kodaikanal are regarded as classical studies in astronomical spectroscopy. The original study of solar prominences, dark markings and other solar phenomena, both from the observational and theoretical aspects, made at this Observatory is significant.

However, it appears that the Observatory has not been keeping pace with modern advances in instrumentation. The following is an extract from the brochure issued on the occasion of the Golden Jubilee of the Observatory:—

"Although outstanding contributions on the theoretical side of astronomy and astrophysics have been made by several Indian workers, the corresponding contributions in practical and observational work have not been so significant largely due to the inadequate instrumental equipment available in Indian Observatories. During the last few years, a number of instru-

ments of basic value in solar research have been built at Kodaikanal, largely through improvisation and local ingenuity at a negligible financial cost. These can and are being utilised for dealing with a variety of problems within their reach; but improvisation, however ingenious, cannot produce the very complex and expensive apparatus of modern astro-physical research which the enormous strides in technological development in the western world have made possible. To mention only the most immediate needs, Kodaikanal Observatory requires a really large solar spectrograph with an adequately powerful coelostat and other accessories, and a Lyot Coronagraph for modernising its activities in solar physics. These requirements can be met only when adequate funds become available."

The Astronomical Planning Committee of 1945 and the Advisory Board of 1948 have made a number of definite recommendations for the improvement of the Observatory. It is learnt that something has been done towards implementing these recommendations; but a great deal more remains to be done to hasten the pace of astronomical research in this country. It is not merely sufficient to remove the disabilities which existing observatories may be lying under. More observatories must also be established in different parts of the country,

staffed by competent and enthusiastic astronomers, and equipped with instruments capable of yielding results of abiding interest and importance.

In this connection it is appropriate to refer to the spirited plea* made by Sir C. V. Raman some time ago on behalf of astronomical research in India, in the course of which he observes:

"It may be asked, why trouble about astronomy? Why spend money on making great telescopes and building great observatories? These are pertinent questions for which my answer would be that an interest in astronomy is a part of the cultural heritage of India, and that we would be unworthy recipients of that heritage if we did not cherish that interest and do our utmost to promote that science. Astronomy is not only the oldest but the grandest of the sciences. Broadly, it may be described as the investigation of the nature of the physical universe. Defined in that way, we begin to realise that astronomy occupies the premier position among the sciences. Indeed, it may be described as a heaven-born river of knowledge which flows to the earth and fertilises the fields of learning and culture."

* *Curr. Sci.*, 1943, 12, 197, 298, 313.

THE OXFORD CONFERENCE ON LOW TEMPERATURE

AN International Conference on Low Temperature Physics was held in the Clarendon Laboratory at Oxford, from the 22nd to the 28th of August, 1951. The conference was conducted with funds made available by the UNESCO, Union de Physique and Institut International du Froid and was attended by more than two hundred delegates from different parts of the world. Fourteen countries, namely, Australia, Belgium, Canada, China, France, Germany, Holland, India, Japan, Spain, Sweden, Switzerland, United Kingdom and the United States of America were represented. About one hundred delegates were from the United Kingdom and thirty-five each from Holland and the United States. The four Indian delegates were Prof. R. S. Krishnan, Prof. F. C. Auluck, Dr. K. G. Ramanathan and Mr. Chandrasekharan.

Lord Cherwell inaugurated the conference. Prof. F. Simon of the Clarendon Laboratory welcomed the delegates. Introductory speeches were made by Dr. Bleany (Oxford) on 'Recent Advances in Paramagnetism' and by Prof. F. London (Duke University) on the 'Two Fluid Theory of Liquid Helium'. The week of crowd-

ed programme consisted of reading and discussion of over one hundred scientific papers dealing with different fields of current research near the absolute zero of temperature. The papers contributed by different delegates dealt with the thermal, electrical and magnetic properties of solids at very low temperatures and on the extraordinary properties of liquid helium. The wide variety of the problems being tackled indicated the enthusiasm with which physicists are using low temperatures for investigating the physics of the solid state. On the last day of the conference, Prof. Fröhlich gave a brief resumé of his theory of supra-conductivity. The general feeling was that considerable amount of both experimental and theoretical work has yet to be done in Low Temperature Physics before one can give a satisfactory explanation of some of the peculiar phenomena observed very near the absolute zero. One was also surprised to find that very little work appears to have been done so far on the optical properties of solids at very low temperatures.

A detailed report of the Conference is being published by the organisers in a few weeks' time.

R. S. K.

WHITHER YEAST GENETICS?

M. K. SUBRAMANIAM

(Indian Institute of Science, Bangalore 3)

CYTOLOGY could progress independently of genetics. Genetics on the contrary is dependent on cytology especially since varying grades of polyploidy have been shown to occur in higher plants. For the past fifteen years, yeast genetics has been pursuing a solitary course. The lack of correlation between genetics and cytology has resulted in a very interesting situation. There are as many alternative explanations for the same phenomenon as there are workers!

Roman, *et al.*¹ found an exceptional ascus, the spores in which developed directly into vegetative cultures and gave rise in turn to spores which showed a 2:2 segregation. This observation is believed to be consistent with the polyploidy hypothesis and they suggest that the irregular ratios reported in the so-called "diploids" (Winge and Roberts²; Lindegren³) are capable of a rational explanation. Such a behaviour by some strains is not something unique. Postulating a "direct diploidization" (*parthenogamy* of other workers⁴) Winge and Laustsen⁵ adduced the above as evidence for an "inbreeding degeneration". Lindegren⁶ also records a similar experience. One of his "illegitimate" diploids which ought to have been homozygous gave a 2:2 segregation. He remarks: "This suggests that the illegitimate diploid was heterozygous and indicates that copulation in the single ascospore culture had occurred after mutation made the haplophase heterogeneous" (p. 120). Fowell's⁷ interpretation of the same phenomenon is at variance with that of the others. He found a baker's yeast producing spores and some of the "hap-

loid" cultures obtained by direct germination of the spores, giving rise in turn to spores. Evidences⁷ are offered to show (p. 184) that both the so-called "diploid" and "haploid" cultures can sporulate. Information, however, is not available regarding the segregation ratios in the spores of the so-called "haploids".

The results in Table I thus demonstrate the inadequacy of even the elementary criteria employed by Winge⁸ and Lindegren.⁹ To evaluate the basic causes responsible for such divergence of views one has to go back to the earlier publications. Winge^{8,5} and Lindegren⁹ differentiate "haploids" from "diploids" on pure morphology. The necessity for cytological confirmation, though realized by both these investigators, is discarded on specious grounds. There appears to be no unanimity regarding the relative importance of the characteristics themselves. Skovsted¹⁰ from Winge's laboratory revealed the limitations of these criteria when he stated that transformation of a haploid into a diploid is "much easier to confirm on morphological character than the change from diploid to tetraploid" (p. 250). If polyploidy does not occur in yeast, morphology may have been of some value. The alternative interpretation offered by Roman, *et al.*¹ dissipates any hope of classifying yeasts into "haploids" and "diploids" without accurate cytological confirmation. Let us now assess the value of the characters on which so much reliance has been placed.

SPORE GERMINATION

Since polyploids and diploids sporulate, the direct germination of a spore is no *prima facie*

TABLE I

Actual observations	Starting material	—→ Ascus—→ Spores—→	Veg. cells from direct germination	—→ Spores—→	2:2 segregation
<i>Interpretations:</i>					
Roman, <i>et al.</i>	Tetraploid	Diploid	Diploid	Haploid	2:2
Fewell	Diploid	Haploid	Haploid	?	No details
Winge	Diploid	Haploid	Nuclear fusion giving diploid	Poor viability explained as due to "Inbreeding degeneration"	
Lindegren	Diploid	Haploid	Copulation between cells of the same mating type—"illegitimate" diploid	Haploid	2:2 segregation due to mutations before fusion of haploid cells

evidence for haploidy. There is an unsubstantiated assumption in yeast literature that *regular meiosis* precedes spore formation. The observation of Fowell⁷ that "haploids" do sporulate and that many of the asci are 4-spored necessitates either the belief, (a) that they are not "haploids" or (b) that meiosis is not regular. Since Roman, *et al.*¹ reported a 2:2 segregation one has to presume that the so-called "haploids" of Fowell,⁷ Lindegren³ and Winge² may not be *real haploids* at all.

CELL SIZE AND SHAPE

Ignoring the statement of Guillermond¹¹ that yeast cells are polymorphic, Winge² as well as Lindegren¹³ have tried to justify the reliability of cell size and shape as a criterion. Winge and Laustsen¹² admit that "the form and size of the cells are very susceptible to various cultural conditions" (p. 113). Curiously enough Winge and Laustsen¹⁴ as well as Lindegren⁹ have offered evidence subsequently that cell morphology is itself gene determined. Ditlevsen¹⁵ in fact describes a "diploid" which seems to show the characteristics of the so-called "haploid" cultures. What is more surprising is that Fowell⁷ (p. 183) reports unusually large highly vacuolated cells in his "haploid" cultures confirming the many exceptions recorded in yeast literature (Lindegren,¹³ p. 209; Winge,⁸ pp. 95 and 97).

MATING TYPE ALLELES

The mating type alleles have been brought in as an additional character to identify the so-called "haploids" when they do sporulate (Fowell, p. 184). When he observes unusually large cells in "haploids" Fowell argues that they are still "haploids" because they do not sporulate. But when "haploid" cultures do sporulate he contends that these are still "haploids" because their cells are smaller in size and show a mating reaction when mixed with cultures of the opposite type. Lindegren⁹ is well aware of the limitations of this character. His "illegitimate" hybrids are the result of fusion of cells of the same mating type. Roman, *et al.*¹ visualize the possibility that "illegitimate" hybridization between cells of like mating type would give "a certain proportion of *aa* and *aa* diploids and the mixing of the two clones by Lindegren's methods should produce tetraploids of the type suggested above" (p. 81).

SPORULATION

According to Winge and Laustsen⁵ "haploid" yeasts do not sporulate. Lindegren and Lindegren³ on the other hand observed sporulation in some haploids (p. 128). Winge and Laustsen¹² record asporogenous "diploids" (p. 114) while

Fowell⁷ agrees with Lindegren that some haploids can sporulate (p. 184). Roman, *et al.*¹ report (p. 80) a 2:2 segregation in spores of cultures which would normally have been identified as "haploids". It is this 2:2 segregation that appears to have prompted them to give a conventional explanation on the polyploidy hypothesis for the supposed curious segregation claimed in the so-called "diploids".

All the radical theories on "gene conversion", "converter stocks" and "cytoplasmic inheritance" in yeasts have been postulated on the belief that the basic criteria are absolutely correct and incontrovertible. These have been repeatedly asserted without ever considering the possibility of an alternative interpretation. In spite of their divergent views^{2,3} on identical problems, Winge and Lindegren have not offered any elucidation even when they recorded several exceptions to their original basic criteria. Entire dependence on morphology is justified on the plea that the confused nature of yeast cytology necessitates such a procedure. Two years back we¹⁶ stated on the basis of purely cytological investigations that much of the work on the genetics of yeasts will have to be re-evaluated in the light of polyploid segregation. That we are right in our approach would be apparent from such a re-appraisal now attempted by Roman, *et al.*¹

In 1947 and 1948^{17,18} we defined the criteria for the identification of chromosomes and evaluated some contributions on the cytology of yeasts. Winge and Roberts¹⁹ admitted the validity of our criticisms (p. 311). Winge²⁰ now states that our cytological investigations are "of a doubtful nature". If as admitted by Winge and Roberts¹⁹ our criteria are acceptable, then our identification of chromosomes based on those criteria ought to be correct. The recent criticism is not based on any *re-definition of nuclei or chromosomes* in yeasts. It appears to be the expression of a personal opinion. The reasons are obvious, in view of the fact that in the paper in which they report the unique phenomenon of the existence of polymeric genes in a strain of whose polyploid nature they admit they are "totally ignorant", they also dispute our demonstration of an induction of polyploidy. Acceptance of our results would render it impossible to characterise their observations as unique.

Winge's²⁰ criticism that the bodies identified by us as chromosomes are not chromosomes because "they are found scattered in the cytoplasm at all stages" and in a varying number" is entirely at variance with the facts published by

us.^{21,22,23} The pictographic summary published by Subramaniam²¹ as far back as 1946 would be sufficient answer that they are not scattered in the cytoplasm at all stages.

Induction of polyploidy in yeasts was claimed by Bauch²⁴ as far back as 1941. It is really surprising that while Winge and Lindegren classify yeast types into "haploid" and "diploid" on the basis of morphology, polyploids identified on the very same morphological criteria by Bauch²⁴ have received scant attention. The basic cause for all this confusion is lack of organized investigations on the cytology of yeasts. It may be relevant in this connection to remember the salutary comment of Fowell.⁷ "There is a deplorable lack of agreement about the identity of chromosomes in yeast, still more about their behaviour during mitosis and meiosis. In the absence of this vital information, it must be considered premature to dismiss all conventional explanations for irregular segregation ratios and even more premature to elaborate unorthodox theories about gene structure and behaviour" (p. 195).

Yeast genetics is thus at the cross roads. Ordered progress in the future depends on a fruitful association with cytology.

* Italics are ours.

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HIDDEN WEALTH IN THE WASTE OF MANGANESE MINES

AS there is a boom in the manganese market, jiggling operations for concentrating small size ore have been started almost at every mine, since ore fragments of the size of one-fifth of an inch thick are marketable. About 50% of the mines are working the so-called "boulder ore" from dumps and virgin ground.

While large amounts of ore of small size termed "Chili" have been reclaimed from the dumps with the help of the improvised jigs, little attention has been paid so far to the 'beneficiation' of the ore from bigger lumps which constitute the major part of the extensive dumps and the *in situ* ore in the veins of some mines. It has been roughly estimated that about three million tons of ore are recoverable from the waste dumps and probably reserves of about 15 million tons exist in the veins. This refers to low grade ore only in the Nagpur and Chhindwara districts. The waste dumps in the Bala-

ghat and Bhandara districts are even more extensive.

The process of reclaiming the ore from the waste will be quite simple and mechanical. Due to high specific gravity of the manganese ores most of the gangue minerals can be separated and the ore concentrated by making use of any of the methods based on gravity. The smaller mines can employ only crushers and carry out the concentration of ore by jiggling. In the case of bigger mines and bigger dumps, beneficiation plants of the heavy media separation type of various capacities can be installed. It is understood that portable units of small size for handling five tons of ore per day are also available.

B. S. LAMBA.*

* Deputy Director, Indian Bureau of Mines,

AGE DETERMINATION STUDIES IN FISHES BY MEANS OF SCALES WITH
SPECIAL REFERENCE TO THE MALABAR SOLE*

G. SESHAPPA AND B. S. BHIMACHAR

(Central Marine Fisheries Research Station, West Hill, Calicut)

ONE of the outstanding achievements of fishery research during the last half-a-century has been the discovery and application of the method of analysis of the age composition of fish stocks based on the study of growth marks on scales, otoliths and in a few instances vertebrae or other bones. The scales are the most widely used for the purpose and the clue to the age of the fish as given by them is a zonation in their structure, there being 'winter' zones of limited or no growth alternating with 'summer' zones of normal growth and the former standing out as distinct growth rings. In general, while the scales of fishes in the temperate countries present a well marked zonation of this type, those of the tropical fishes seem to lack such distinct markings. In the temperate countries the scale method of age-determination has been used extensively in the case of a large number of species of food fishes.

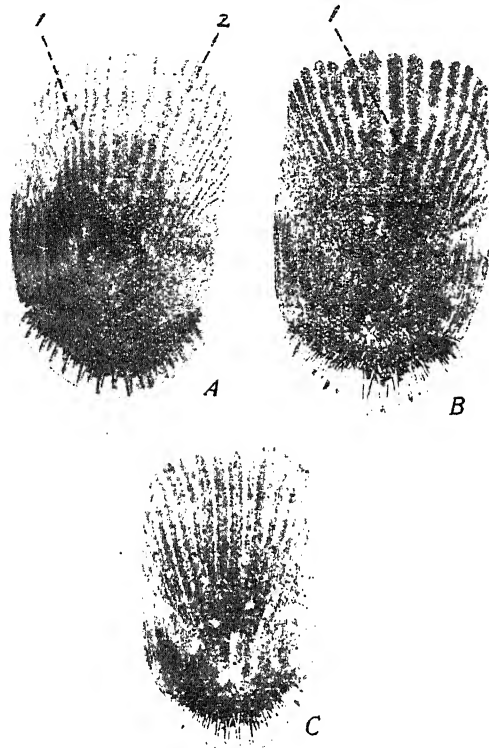
In India, while work on the age-determination of fishes has been extremely limited, the work that has been done so far on *Hilsa ilisha* and *Sardinella longiceps* have given discouraging results. While some growth rings are known to occur in these two species, there is wide divergence of opinion regarding their exact significance and consequently it has not been possible to utilize them for age-determination. In *S. longiceps*, Hornell and Nayudu¹ have observed not more than two rings and mention that the period of arrested growth coincides with the period of plankton scarcity from January to April. Devanesan² reports many more than two rings and says, "an interpretation of them is beset with difficulties owing to want of collateral researches like marking experiments". But Nair³ records three growth rings in the otoliths of this species and considers that the average life span of the oil sardine is about three years. In the case of *H. ilisha*, Hora and Nair⁴ assume the annual nature of the rings and suggest that *Hilsa* has a life-span of 5 to 7 years. But Prashad, Hora and Nair⁵ report as many as 8 rings and say, "though with the information available at present it is not possible to interpret the exact significance of the scale rings of *Hilsa*, we

believe that they are formed not at regular intervals but whenever the conditions of life become unfavourable". Chacko and Krishnamurthi⁶ suggest that the growth rings of *Hilsa* indicate the number of times the fish has spawned. Chacko, Zobairi and Krishnamurthi⁷ and Sundara Raj⁸ suggest that the transverse radii (and not the growth rings) give an indication of the age of the fish. Jones and Menon⁹ state that though the number of these radii increases with the size of the scale and the length of the fish it is difficult to draw a correct relationship between the radii and the age of the fish. They are also unable to interpret the exact significance of the growth rings. Writing about these growth rings, Sundara Raj¹⁰ states, "These growth rings on *Hilsa* are too numerous to be considered annual growth rings or 'annuli'. Consequently they cannot in the present state of our knowledge provide any evidence of age or rate of growth and must be discarded. This seems to be true also of other tropical fish. Thus to the fishery investigator in India this important clue to the age and rate of growth of fish is denied".

Under these circumstances it is considered worthwhile to report certain of our observations on the Malabar sole, *Cynoglossus semifasciatus* Day, made during the course of our studies on the biology of this species. *C. semifasciatus* is one of the top-ranking food fishes of the Malabar coast. We have noticed in the scales of this species, the occurrence of certain distinct annuli which appear to be formed regularly every year under the influence of the South-West monsoon and which can be used in age-determination and thus in the assessment of the year-class composition of the fishery. These annuli were first noticed in the latter part of 1949 in the scales of the larger individuals in the fishery and have since then been studied in detail. They resemble the annuli described for several flat fishes such as *Lophopsetta aquosa*,¹¹ *Platichthys stellatus*,¹² *Citharichthys sordidus*¹³ and *Pleuronectes microcephalus*¹⁴ and are distinct from the rest of the scale by the following features: (i) the narrowing of the sclerites and the closing up of the intervals between successive sclerites, (ii) the sclerites, wavy and broken up elsewhere, becoming continuous and nearly straight from radius to radius, (iii) an increase in the number of

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam.

radii outward of the annulus, the new radii commencing just near the annulus, and (iv) the portions of the radii outward of the annulus being frequently not in a straight line with the portions inward of it, but inclined at an



Photomicrographs of Scales of *Cynoglossus semifasciatus*.

A. Scale showing two annuli. $\times 10$. (Female, total length 15.5 cm., ovary in stage V, captured on 17th January 1951). B. Scale showing one annulus. $\times 10$. (Female, total length 15.6 cm., ovary in stage V, captured on 9th May 1951). C. Scale showing no annuli. $\times 10$. (Female, total length 11. cm., ovary in stage III, captured on 9th May 1951).

angle or even disconnected at the annulus. Photomicrographs A, B and C show scales of *C. semifasciatus* with two, one and no annuli respectively. Scales with more than two annuli have not been noticed so far. Several otoliths have also been examined but no rings have been noticed in them.

The breeding season in the case of the Malabar sole is spread over a long period, starting from about October and continuing up to about May of the following year. There is thus a very short break in the recruitment of young ones to the fishery and except during the earlier months of the breeding season when the new recruits remain quite distinct from the members of the older generations, it is difficult to recognize the different age-groups by means of a length frequency curve as the modes in the latter do not stand out clearly. During the year 1950-51 however, it was possible to watch carefully the stock of the preceding pre-monsoon period during its passage through the fishery, by a study of periodical random samples taken during different months of the year. The following table summarizes the data relating to the occurrence of growth rings in random samples of this stock during the period September, 1950, to December, 1950.

As is evident from this table, the rings appeared gradually at the margins of the scales and growth occurred subsequently outside the rings. While the majority of the individuals examined in September had already developed the annuli by then, in others the appearance of the annuli was noticed only a little later. But in November out of 248 individuals, only two were without rings and of the others only two had 'closed' (that is, still not growing) margins. In December and subsequent months all individuals of the previous pre-monsoon generation without exception, revealed the presence of rings and 'open' (that is, growing) margins. Large numbers of individuals of the new post-monsoon generation (which were widely distinct from the rest until February) were also examined and found to have no annuli at all. No rings were found on the scales of the new recruits during the year 1949-50 also, and no 'closed' margin phase occurred in individuals of any size before the monsoon season.

The growth rings occurring in the scales of fishes in the temperate countries are indicative of seasonal differences in growth and are obviously related to the regularly occurring seasonal

TABLE I

	September	October	November	December
1 Total number examined	405	81	248	102
2 Number with no rings	45	16	2	0
3 Number with one ring and 'closed' margin	178+23 (not clear)	9+2 (not clear)	0+2 (not clear)	0
4 Number with one ring and 'open' margin	124+15 (")	46+1 (")	234	95
5 Number with two rings and 'closed' margin	12+4 (")	1	0	0
6 Number with two rings and 'open' margin	1+3 (")	6	8+2 (not clear)	7

differences in the environmental factors. The general lack of growth rings in the scales of the tropical fishes as well as the indistinctness of and the difficulty in the interpretation of such marks of growth check as do occur in some of the species must be mainly due to the fact that the seasonal differences in the tropical countries are neither similar to nor so well marked as in the temperate countries. There is some evidence to show that the growth rate of fishes suffers a decrease and rings tend to be formed in the scales whenever environmental conditions such as for instance, food and temperature, are unfavourable.^{15,16} In some Indo-Chinese species of fishes Chevey¹⁷ has noticed growth rings in the northern but not in the southern region and he attributes this to temperature differences between the two areas; he also records¹⁸ some exceptional species from Cochinchina in which the growth rings are found and considers that the rings are caused by the rhythmical occurrence of favourable and unfavourable conditions of nourishment in the environment. The usefulness of the rings found in the scales of any fish for age-reading would therefore depend upon the frequency and the cyclical regularity with which conditions unfavourable to the growth of the species occur in its environment.

Along the Malabar coast, the environmental conditions in the inshore sea during the monsoon months (June to August), are quite distinct from those during other months of the year, and are characterised by a sharp fall in salinity and temperature, a high turbidity and turbulence and above all by the sea bottom becoming severely depleted of the organisms which form the chief food of *Cynoglossus*. The last point has been brought out clearly by our studies of the feeding habits of the Malabar sole and by the study of the bottom fauna near Calicut by one of us (G. S.). The change in the environmental conditions seems to occur regularly every year more or less during the same period and thus the events are regularly cyclical. It seems reasonable under these circumstances to conclude that the annuli mentioned above are annual rings formed under the influence of the South-West monsoon season and it would be appropriate to name them *monsoon rings*. The main factor causing the formation of these rings appears to be the lack of food leading to starvation. They are not spawning marks because even individuals that have clearly not yet reached the first spawning stage show them, provided they do not belong to the current year's brood.

Our studies of the scale rings of *C. semifasciatus* indicate that no individuals of this species which have survived more than two mon-

soon seasons occur in this area and that fish which have passed through two monsoon seasons themselves form a very insignificant part in the fishery. These studies also indicate that during the 1949-50 and 1950-51 fishery seasons the great majority of the soles contributing to the fishery were the direct result of previous season's spawning, the catches of the peak period (September-November) being traceable to the stock of post-larvæ and young soles occurring in the area during the months preceding the monsoon. Whenever the fishery extends beyond the usual season, that is, into the pre-monsoon months of the next calendar year, the bulk of the catches of these later months is likely to consist of recruits of the same season. While it is yet too early to reach any far-reaching conclusions as to the application of these results, a systematic collection of data for some more years should prove to be of considerable value in evolving suitable methods for the management of this important fishery.

It is suggested that annuli similar to those seen in *C. semifasciatus* are likely to occur in other species of the area, especially if they are mainly dependent on the bottom fauna for food. It also seems reasonable to assume that a search for annual scale rings would be worthwhile, even in the tropical countries, wherever the environmental conditions differ markedly and regularly between one part of the year and another.

We are thankful to Professor B. R. Seshachar for help in getting the scales photographed, and to Dr. N. K. Panikkar for helpful criticism.

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LETTERS TO THE EDITOR

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THE PHYSICAL SIGNIFICANCE OF A CLASS OF METRICS

It is obvious that the Riemannian metric of general relativity cannot always be reduced to the form

$$ds^2 = -A dx^2 - B dy^2 - C dz^2 + D dt^2, \quad (1)$$

where A, B, C, D are functions of co-ordinates. It is well known that if the metric is to reduce to the above form the coefficients of rotation (Eisenhart, 1949 a) must satisfy the conditions,

$$\gamma_{ijk} = 0, \quad (i \neq j \neq k) \quad (2)$$

for an associated orthogonal ennuple. The question naturally arises as to what is the physical significance of the conditions (2). So far this has not been answered.

Recently, while examining the distant-parallelism theory of Einstein (1928 a, b; 1929) which was later modified by Levi-Civita (1929), we noticed that the electromagnetic field totally disappears for a metric of the form (1). In the

theory, the gravitational field is given by the equation in quadruplet tensors,

$$G_{ik} - \frac{1}{2} \delta_{ik} G = -K T_{ik}, \quad (3)$$

where K is the usual constant. The electromagnetic quadruplet tensor F_{ik} is defined by

$$F_{ik} = \nu \sum_1^4 e_i \gamma_{ikl} ds_l, \quad (4)$$

where $e_1 = e_2 = e_3 = -e_4 = -1$, $\frac{d}{ds_l}$ is the operator of directional differentiation and ν is a constant.

When we make use of the conditions (2) and the identities (Eisenhart, 1949 b).

$$\frac{d\gamma_{lpp}}{ds_r} - \frac{d\gamma_{rpp}}{ds_l} + e_l \gamma_{lpp} \gamma_{rpp} - e_r \gamma_{lpp} \gamma_{rpp} = 0, \quad (5)$$

we can easily verify that the components of the electromagnetic field vanish. This interesting result does not seem to have attracted attention before.

In the more recent theories of Einstein and Schrödinger unifying the gravitational and elec-

OPTICAL means of detecting radio-frequency resonance among the Zeeman levels of an atom in a magnetic field have been sought for and discussed by many workers.^{1,2,3,4} Bitter¹ was the first to suggest that the intensity, polarisation and frequency of the optical radiation emitted, corresponding to transitions between two levels, are altered when one of the levels is under radio-frequency resonance. Pryce² showed that the magnitude of the effect was proportional to the r.f. magnetic field and that it would be rather difficult to observe the optical changes unless the Zeeman components are almost completely resolved. Although the direct

observation of the changes in the optical radiation is difficult, it occurred to the authors that the magneto-optic rotation, which is very sensitive, particularly near the absorption line, to the magnitude of the Zeeman splitting, would be an excellent means for detecting the radio-frequency resonance. The order of magnitude of the effect to be expected is discussed below.

The energy levels of an atom in the $^2S_{1/2}$ state placed in an r.f. field has been calculated by Pryce² to be

$E = \pm \frac{1}{2} \hbar \omega \pm \frac{1}{2} [\hbar^2 (\omega_0 - \omega)^2 + (g \mu_0 H_{r.f.})^2]^{1/2}$, where ω , ω_0 and $H_{r.f.}$ are respectively the applied frequency, the resonant frequency and the r.f. magnetic field. Fig. 1 shows how the

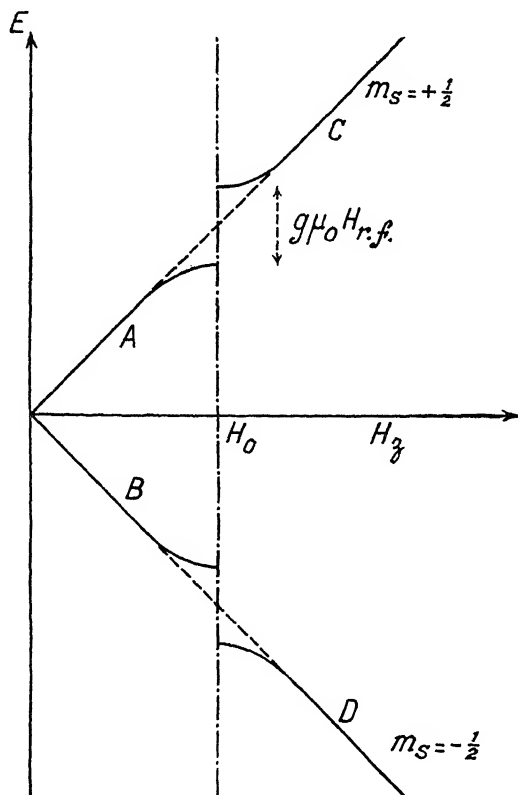


FIG. 1

energy levels vary with the magnetic field H_z . On approaching resonance the energy difference between $m_s = +\frac{1}{2}$ and $m_s = -\frac{1}{2}$ increases with H_z at a rate slower than it would in the absence of the r.f. field. At resonance the levels are interchanged on account of the absorption and emission of r.f. quanta. Thus, the energy of an atom originally in the state $m_s = +\frac{1}{2}$ increases with the magnetic field and follows the curve A in Fig. 1. At resonance the atom emits an r.f. quantum of energy $\hbar \omega_0$

and goes over to state $m_s = -\frac{1}{2}$ and follows the curve D. Similarly the energy of an atom in the state $m_s = -\frac{1}{2}$ goes from curve B to C by the absorption of a quantum at resonance. The four effective levels given by the curve exist only at resonance and not over a range about resonance as a cursory examination of the curve appearing in Pryce's paper might indicate. It is to be noted that the energy levels are different on either side of resonance. Consequently the Zeeman splitting of the spectral lines arising from transitions from a higher level to a level under the action of an r.f. field will be slightly different before and after resonance. The magnitude of the difference would be approximately $2g\mu_0 H_{r.f.}$.

Now the magneto-optic rotation is dependent on the magnitude of the Zeeman splitting of the states of an atom. From the classical experiments of Wood⁵ on the magneto-optic rotation in sodium vapour we know that even at 2 Å away from the absorption frequency the magnetic rotation is of the order of 0.2° per Oerstead. At moderate radio-frequencies (~ 100 m.c.) it is possible to attain r.f. fields of the order of 1 to 10 Oersteds. The constant magnetic field required to produce resonance at this frequency is about 35 Oersteds. Thus, if the reasoning given above is correct, we should expect to find a sudden change in the magneto-optic rotation of the order of 0.1° to 2° on crossing the resonance value.

The magnitude of the magneto-optic rotation is also dependent on the transition probabilities associated with the lines whose frequencies are shifted by $g\mu_0 H_{r.f.}/\hbar$. That these transition probabilities are not very different from the values when the r.f. field is absent is evident from Pryce's calculations. Even if the transition probabilities are much smaller in the r.f. field, it should be possible to detect by electronic methods the variations in the magneto-optic rotation near resonance.

Periodic fractional changes in light intensity of the order of 10^{-7} can be detected by the use of a photomultiplier tube with a tuned amplifier having a narrow band-width. So by amplitude or frequency modulating the r.f. it should be possible to detect changes in rotation of the order of 0.1" of arc. Experiments have been undertaken to verify the above ideas.

It may be mentioned that the effects discussed above are quite different from the changes in magneto-optic rotation that may occur due to equalisation of population in *paramagnetic resonance* which however will be prominent only at low temperatures.

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ON THE OCCURRENCE OF TWO-WINGED POLLEN IN THE TRIASSIC ROCKS OF THE SALT RANGE, PUNJAB

SOME years ago, the author¹ described a number of siliceous casts of micro-organisms from the Triassic rocks of the Salt Range, Punjab. About an year after the publication of the paper describing these micro-fossils, Dr. D. D. Pant of Allahabad was good enough to examine the original specimens. He suggested that they were most probably casts of two-winged spores. He has since then published a note in *Nature*² in which he says that they should be referred to *Pityosporites* Seward. In view of Pant's observations, it seems useful to give the correct botanical description of the fossils. The author believes that Dr. Pant is right in interpreting them as casts of two-winged spores.

Description.—The specimens are preserved in the form of siliceous casts of a red-brown colour which is due to the presence of iron oxide in the infilling material. The surface does not show any ornamentation and the specimens appear in some cases to have suffered distortion. Owing to the imperfect preservation the correct form and sculpturing of the spore body is not seen and it renders comparisons difficult. If the specimens are internal casts like the megaspores associated with them, one should expect signs of a reticulum in the region of the bladders. The casts, however, show a uniform smooth texture.

There are at least two spore types present. The first has swollen distally inclined bladders as in *Pityosporites* Seward. The specimens measure about 145 μ from wing to wing. In the second type the bladders are not swollen and are placed symmetrically on either side of the central body. This type is more comparable to *Alisporites* of Daugherty. The specimens in this case are slightly larger (148 μ).

Both *Pityosporites* and *Alisporites* have been redefined by Schopf, Wilson and Bentall.³ The more restricted use of the two generic

terms suggested by these authors calls for accurate comparisons which are not possible with the present badly preserved specimens. The Salt Range fossils are therefore not being assigned to these genera, though resemblance with them is obvious. They are more conveniently described by Naumova's more elastic terminology, *Saccata* with its further divisions *Oedemosaccus* (air sacs swollen) and *Platysaccus* (air sacs flat).⁴

Two-winged spores of the *Pityosporites* and the *Alisporites* type have been previously recorded in India both from the Lower and Upper Gondwana rocks. They occur in the Salt Range in the Permo-Carboniferous and the Permian beds⁵ and the Jurassic rocks of the Rajmahal Hills, Behar.⁶ We now know that these types ranged uninterrupted in the Gondwana flora of India from the Permo-Carboniferous through the Trias to the Jurassic period. The present spores are characterised by their rather larger size as compared to the Palaeozoic and the Jurassic types from India.

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VITAMIN B₁₂ AND NITROGEN EXCRETION BY HUMAN ADULTS

PATWARDHAN, *et al.*¹ and Karambelkar, *et al.*² have reported that adult human subjects excreted more nitrogen through urine on animal protein rich diets than on diets containing the same quantity of total proteins, but where the protein was chiefly of vegetable origin. No satisfactory explanation for this observation has yet been found. Various workers have suggested (see below) that vitamin B₁₂ influences favourably the utilisation of dietary protein. Further, a close relationship between "Animal Protein Factor" and vitamin B₁₂ has been reported by Ott, *et al.*³ In view of these facts, it was considered worthwhile testing the effect of the former on the urinary nitrogen excretion in human subjects maintained on diets providing

protein mainly of vegetable origin. That vitamin B₁₂ promotes the utilisation of protein in rats and of amino acids in chicks has been observed by Hartman, Dryden and Cary⁴ and Charkey, *et al.*⁵ respectively. Abbot⁶ observed that injection of vitamin B₁₂ resulted in marked nitrogen retention in rabbits on unrestricted diets. The positive nitrogen balance, however, was slight when the diet was restricted. Marfatia and Sreenivasan⁷ have recently reported significant increases in the biological value and digestibility coefficient of low quality protein mixture on supplementation with vitamin B₁₂. The following experiment was undertaken to find out if vitamin B₁₂ exerted any influence on protein metabolism in human adults.

Two healthy male adults volunteered as the subjects for this experiment. They were fed on a controlled diet of the following composition: Cereals 530 gm., Pulses 90 gm., Leafy vegetables 100 gm., Non-leafy vegetables 150 gm., Whole milk powder 14 gm., Sugar 70 gm., Vegetable oil 50 gm., Condiments and spices 30 gm., Tea leaves 15 gm. The diet had the total caloric value of 3,260 and provided 76.6 gm. protein (12.25 gm. N), of which only 3 gm. were animal protein, the rest being derived from cereals, pulses and vegetables.

After two weeks on experimental diet for the attainment of steady state with respect to urinary nitrogen excretion, the collection of urine and faeces for nitrogen determinations was made continuously for eight days. Then 15 µg of vitamin B₁₂ were administered intramuscularly. A second dose of 15 µg was repeated on the fourth day following the first one. The urine and faeces were collected continuously for six days from the first administration of vitamin B₁₂ and nitrogen determined in the excreta. The average figures for daily N excretion in urine and faeces during the control and B₁₂ supplementation periods are given in the following table:

TABLE I

Subject	Control period ¹		After vitamin B ₁₂	
	Nitrogen excretion per day in g.		Nitrogen excretion per day in g.	
	Urine	Faeces	Urine	Faeces
C.S., 29 years. Body weight 138 lb.	5.46	1.64	5.53	1.45
N.K., 30 years. Body weight 112 lb.	7.33	1.66	7.19	1.76

It can be seen from the results that there has been no significant difference in the urinary and faecal nitrogen excretion on a daily intake of 12.25 gm. N, hence no appreciable change in nitrogen retention could be detected in both the subjects between the control and vitamin B₁₂ periods. The figures for faecal N also indicate that there has been little change in the digestibility of protein subsequent to administration of vitamin B₁₂.

Although there is considerable evidence to show that vitamin B₁₂ has an important role to play in amino acid metabolism (Schäfer, Salmon and Strength,⁸ Oginsky,⁹ Jukes, Stockstad and Broquist¹⁰) it has not always been possible to demonstrate its effect on the utilisation of dietary protein. Some of the evidence published on this aspect is more or less circumstantial. Chow and Barrows¹¹ observed better growth in young rats on vitamin B₁₂ supplementation to a soya bean protein diet without any change in the biological value of the protein. They attributed this to a possible role of the vitamin in carbohydrate or fat metabolism. Rupp, *et al.*² have also reported that vitamin B₁₂ administered to rats receiving constant food intake exerted no influence on nitrogen retention. McCollum and Chow¹³ found greater growth in female rats after injection of vitamin B₁₂ with high carbohydrate diets which suggested that vitamin B₁₂ is possibly involved in the conversion of carbohydrate to fat. Chow¹⁴ did not notice any increase in nitrogen retention when vitamin B₁₂ was given parenterally to infants fed on soyabean protein diets.

The conclusions regarding the influence of vitamin B₁₂ on protein utilisation to which a reference has been made above were based mainly on the increased rate of growth observed in the animals. The increase in growth rates on vitamin B₁₂ supplemented rations was probably the result of increase in food consumption to which attention has been drawn by the workers concerned. So far as the published evidence goes, it must be admitted that unequivocal proof of the existence of a specific effect of vitamin B₁₂ on the utilisation of dietary protein is still lacking. Our own observations reported above, limited as they are, lend no support to this view.

Further work on adults and children is in progress and will form the subject of a fuller communication to be published elsewhere.

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AMINO ACIDS IN FINGER SEED (RAGI KURAKKAN) ELEUSINE CORACANA

My attention has been drawn to a paper by Lal¹ in which he concludes that Ragi (*Eleusine coracana*) and Bengal Gram (*Cicer arietinum*) are totally deficient in the essential amino acid threonine. A paper published by me² a little earlier gives the threonine nitrogen content of Kurakkan (as this cereal is called in Ceylon) as 3.2% of the total nitrogen present, the determination being carried out on the fat extracted material by the periodate oxidation method.³ Numerous threonine estimations by this method have been made during the last three years on a variety of foodstuffs in this laboratory; close agreement has been observed with the values obtained by the method of microbiological assay.

A total deficiency of threonine in Ragi would militate against the use of this valuable millet in tropical dietaries. It was considered desirable therefore to confirm by microbiological assay the threonine value obtained by the oxidation procedure. For this purpose, two hydrolysates of the fat extracted cereal were prepared, one by hydrolysis essentially according to Lal's procedure and the other by boiling for 24 hours with excess of 20% hydrochloric acid. Each hydrolysate was assayed with each of two different media,^{4,5} the organism used being *Streptococcus faecalis*. The results for each hydrolysate with the different media were in close agreement and averaged as follows:—

Threonine N (in pressure hydrolysate)	= 3.04% of total N.
Threonine N (20% HCl hydrolysate)	= 2.95% of total N.
Mean	= 3.00% of total N.

This value is in good agreement with the value 3.2% obtained by the periodate oxidation procedure. If the threonine nitrogen is taken as the mean of these two figures, the percentage of threonine in Ragi (anhydrous, lipid free, N = 1.26%) works out as 0.332%.

As the lipid content of the whole millet is small (of the order of 1-2%), it is seen that a value of 0.32-0.33% would be representative of its threonine content on an anhydrous basis. It would appear unlikely also that Bengal Gram is lacking in threonine as this essential amino acid appears to be fairly uniformly distributed in other legumes.

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THE "PHENOLASE" FROM BRINJAL (*SOLANUM MELONGENA*)

HIGHLY purified phenolase preparations have been prepared from potato,¹ common mushroom,² wild mushroom,³ sweet potato⁴ and the field bean (*Dolichos lablab*).⁵ All these phenolases excepting that from wild mushroom have been shown to oxidise polyphenols, viz., catechol, very rapidly. The phenolase from wild mushroom however was shown to be 10 times more active towards monophenol-p-cresol than towards polyphenol-catechol. The pressed juice of the brinjal (*Solanum melongena*) rapidly darkens in air, indicating the presence of a phenolase, which has now been elucidated.

The dark juice obtained from brinjals by mincing and pressing was treated with an equal volume of anhydrous acetone. The resulting precipitate which practically contained the whole of the enzyme, was redissolved in the minimum amount of water. The dark solution on saturation with ammonium sulphate, precipitated the enzyme. The precipitate was taken up in water and dialysed against run-

ning water. To the dark red solution thus obtained, the required quantity of 0.1 saturated basic lead acetate was added so that a brown turbid solution containing about 70 per cent. of the original enzymic activity was obtained. To this solution a small quantity of calcium phosphate gel was added to remove the turbidity. The colour of the enzymic solution thus obtained was light brown. The enzyme in the solution was further purified by two successive adsorptions on $\text{Ca}_3(\text{PO}_4)_2$ gel and two successive elutions with K_2HPO_4 solutions. This brown coloured solution was used for a study of properties of the enzyme. It could be further purified by treatment with basic lead acetate solution at pH 7.5.

The following table indicates the effect of purification on the activity of the enzyme as determined manometrically towards a representative polyphenol (catechol) and monophenol (p-cresol).

The results are expressed in terms of QO_2 , i.e., uptake of oxygen in c.mm. as measured in a warburg manometer per mg. enzyme per hour. The uptake per hour was determined on the basis of uptake in the first two minutes of the reaction.

The optimum pH with catechol was found to be 6 and optimum concentration of catechol as the substrate to be 2 mg. in the final volume of 2.5 c.c. The corresponding values for p-cresol were pH 7 and 10 mgms. respectively.

Activity of the enzyme during different stages of purification

No.	Purification Stages	QO_2 Catechol	p-Cresol	Ratio of Catechol to p-Cresol
1	Crude juice	12	8	1.66
2	Precipitate with acetone in water	86	41	2
3	Precipitate with ammonium sulphate in water	596	208	3
4	Filtrate after lead acetate precipitation	910	170	5.3
5	Filtrate after 1st adsorption on $\text{Ca}_3(\text{PO}_4)_2$ gel	1123	180	6.1
6a	Enzyme absorbed on $\text{Ca}_3(\text{PO}_4)_2$ gel eluted	1770	209	8.9
6b	Enzyme (6a) absorbed on $\text{Ca}_3(\text{PO}_4)_2$ gel. and eluted	3725	195	19
7	Enzyme solution after lead acetate precipitation	4529	160	28

From the above table it is clear that there is a progressive increase in the activity ratio catechol: p-cresol. Further, the oxidation of p-cresol was found to commence after a lag period.

which also increased with progressive purification. This lag period can be reduced by adding a trace of catechol to the system.

The brinjal phenolase, like the phenolases from mushrooms, potato and sweet potato was found to be a copper protein containing 0.2% copper, and was inhibited by NaCN, H_2S and sodium diethyl dithio carbamate. Of the monophenols and polyphenols tested such as phenol, p-cresol, tyrosine, catechol, hydroquinone, p-phenylenediamine, pyrogallol, phloroglucinol, catechol was found to be the most reactive towards the enzyme.

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INFLUENCE OF ANTIBIOTICS ON THE GROWTH OF THE SILKWORM *BOMBYX MORI*

INTESTINAL flora of animals are known to exert a beneficial effect on their hosts by synthesising vitamins and growth factors. This was first demonstrated in the case of rats in 1927.¹

Black, et al.² reported a retardation in the growth of rats by feeding them with sulphaguanidine at a level of .5 per cent. This finding was extended by others^{3,4,5,6,7} who used other sulpha drugs as bacteriostatic agents. Daft and Sebrell⁸ and Elvehjem⁹ have reviewed much of this work.

More recently, however, certain chemotherapeutic agents, when orally administered, have been shown to promote an increased response of growth in various species of animals. Succinyl sulphathiazole, arsonic acid derivatives,^{10,11} crystalline antibiotics^{11,12,13} and crude fermentation products prepared from antibiotic fermentations,^{14,15} have, for example, been found to exert pronounced growth-promoting activity in chicks, rats and pigs.

In the course of our studies on the nutrition of the silkworm, we were confronted with the problem of avoiding heavy intestinal infections among silkworms, particularly when they were fed with mulberry leaves supplemented with protein hydrolysates. The use of antibiotics in controlling diseases, viz., diarrhea has been reported by Carpenter¹⁶ in his recent studies of the

effect of antibiotics on the growth of swine. Our object in using the antibiotics, penicillin and streptomycin, along with the protein hydrolysates, was to determine if the micro-organisms responsible for the intestinal diseases of the silk-worm could be controlled.

Two batches of each of 10 silkworm larvæ of the Mysore-Japanese cross-breed (Mysore X C. Nichi₁), immediately after the III moult, were employed to determine the effect of each of the supplements. The average initial weight of the larvæ was near about 800 mg. and the weights of the batches did not differ from the average by more than 0.65 per cent. For each group of 20 larvæ under a given treatment 200 mg. portions of acid hydrolysates of casein, gelatin, and silk were fed twice a day during the IV instar and four times a day during the V instar. The larvæ were observed to consume about 50 per cent. of the supplement during the IV instar and about 25 per cent. during the V instar.

In the case of larvæ which received an antibiotic 1,000 units of penicillin or 20 µg. of streptomycin were given on alternate days along with the feed for each group. The average increase of weights of 10 larvæ commencing from the start of the experiment to the time of mounting are given in the following table.

The data given in the table show that penicillin and streptomycin when administered to the

to elucidate the mechanism of the beneficial action of antibiotics on the growth of the worm and the yield of silk.

Our grateful thanks are due to the Governments of India and Mysore for their financial assistance and to the Director, I.I.S., for his kind interest.

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Treatment	Protein hydrolysates without antibiotics			Protein hydrolysates with antibiotics			
	Leaf + casein hydrolysate	Leaf + gelatin hydrolysate	Leaf + silk hydrolysate	Leaf + casein hydrolysate + streptomycin	Leaf + casein hydrolysate + penicillin	Leaf + gelatin hydrolysate + penicillin	Leaf + silk hydrolysate + penicillin
Average increase of weight of 10 larvæ during experimental period (in g.)	15.7066	15.6434	15.7765	16.8747	16.7215	16.7177	16.3067

larvæ along with protein hydrolysates help to bring about a definite and significant increase in the body weight of the larvæ, varying between 2.5 to 6.8 per cent. It is suggested that these antibiotics, as in the case of similar studies, exert a beneficial influence in controlling the intestinal flora of the larvæ. It has also been found that higher meterages of reelable silk are obtained with cocoons spun by worms fed on diets fortified with antibiotics. These studies are being extended to other antibiotics, viz., chloromycetin, aureomycin, terramycin, with a view

TREATMENT OF RICE SEED IN NUTRIENT SOLUTIONS AS A MEANS OF INCREASING YIELD

STUDIES on the effect of soaking the seed prior to sowing in nutrient solutions have been made by Gusev,¹ Roberts,² Narayanan and Gopalakrishnan³ and Chandraratna and Abeyaratna.⁴ In view of earlier success recorded by Roberts² with cereals in Great Britain and considerable economy in fertilizer use effected by this method, work on soaking of rice seed in nutrient

solutions was started in 1948, at the Central Rice Research Institute, Cuttack, to see how far this method could be utilised to correct mineral deficiencies in soil, to obtain higher yields of grain. A number of chemicals each at three concentrations 2M, M and M/2 and treatment with cow dung paste and water soaking were tried. Soaking of seed was done in 1/3 its weight of nutrient solution for 24 hours in an end-on shaking apparatus to effect uniform mixing. The treated seeds were then sun-dried and stored in closed containers for nearly 30-40 days before sowing. No adverse effect on germination was observed due to storage. The treated seeds were then sown in phosphate deficient soil, in lines, in small plots with a split block design. All treatments were tried with and without a basal dressing of sulphate of ammonia to supply 20 lb. nitrogen per acre. Early variety of paddy T. 608 of 120 days' duration was used for the experiment. The experiment has been conducted for two cropping seasons at the farm area and the yield data obtained during the two seasons reveals that treatment with solutions of chemicals K_2HPO_4 and K_3PO_4 gives yields significantly higher than that of control. There was, however, no significant difference between concentrations of chemicals, except with $(NH_4)_2HPO_4$, which at higher concentrations 2M and M depressed the germination considerably and pulled down the yield. All the chemical treatments affected the germination of seed and stand in the treated plots was about 10-15% lower than that in the control plots. The effect on germination was, however, less at concentration M/2 than at higher concentrations. Mean yields in lbs. per acre for chemical treatments at concentration M/2 are given in the following table:

No.	Chemical	Stand at harvest	Yield in lb./acre	% over control
1	KH_2PO_4	87	835	101.3
2	K_2HPO_4	92	1003*	121.7*
3	K_3PO_4	94	951*	115.4*
4	$NH_4H_2PO_4$	92	930	112.9
5	$(NH_4)_2HPO_4$	89	839	101.8
6	NaH_2PO_4	98	912	110.7
7	Na_2HPO_4	92	924	112.1
8	$(NH_4)_2SO_4$	94	783	95.0
9	NH_4NC_3	89	920	111.6
10	Cow-dung paste	76	901	109.3
11	Water soaked	93	877	106.4
12	Untreated control	100	824	100.0

* Significant at 5% level.

It is seen that chemicals K_2HPO_4 and K_3PO_4 at concentration M/2 give yield increases of 21.7% and 15.4% respectively, over a control yield of 824 lb. per acre. At higher concentrations, the yields obtained were lower than that at concentration M/2.

Further experiments to study the efficacy of this mode of seed placement of fertilizer at different locations, levels of soil fertility and for different durations of rice varieties are being tried. The method is also being field tested on a large scale on cultivators fields and fuller details of these trials will be published in a separate communication.

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EFFECT OF PRE-SOWING LOW TEMPERATURE TREATMENT AND POST-SOWING LONG DURATION OF LIGHT ON THE FLOWERING IN WHEAT

THE note gives a preliminary report of the investigation by the author on the developmental physiology of wheat since 1947. Experiments in 1947-48 indicated that Pb591 (a late variety of wheat) showed significant earliness in earing (7.2 days) due to low temperature treatment of seed; exposures to long duration of light resulted in an earliness by 22.25 days. Since 1949 the growth, development and yield of two varieties of wheat, viz., Pb591 (late) and C13 (early variety), as influenced by pre-sowing low temperature treatment of seeds and post-sowing long duration of light, are under study. Pedigree seeds of two varieties were used and the plants were cultured in earthen pots of 10" diameter filled with a mixture of field soil and compost in the proportion of 2:1

The pre-sowing low temperature treatment of seeds consisted of soaking the seeds for 7 hours in water and subjecting them to low temperature (34-37° F.) in a refrigerator for 5 weeks (11 Oct. to 15 Nov.).

Five plants were maintained for the final observations. The light treatments were given for the entire life-cycle; the long durations of light consisted each of exposures to 18 hrs. and 24 hrs.

by supplementing the natural day light by a 500 watt electric bulb kept at a distance of 6' from the ground. There were in all twelve treatments, *viz.*, varieties 2, seed treatments 2 (vern. & cont.), and light treatments 3 (Normal day light,* 18 hrs. and 24 hrs. day light). Sowing was also done on 16th Nov. The maximum temperature ranged from 86-102° F. in light and 81-99° F. in normal day and minimum temperatures from 35-57° F. in normal day and 33-59° F. in light.

TABLE I (a) and (b)

Effect of low temperature seed treatment on flowering

Treatments	No. of days taken	Critical difference	No. of days taken		Critical difference
			C13	Pb591	
V	49.5	.86 @ 5%	44.0	52.4	1.47 @ 5%
C	55.3	1.16 @ 1%	47.7	61.5	1.93 @ 1%

Flowering was significantly (1%) hastened as a result of vernalisation, the earliness being 5.8 days Table I (a). From Table I (b) it is seen that the response of the early variety C13 was significantly less (3.7 days) as compared to the late variety Pb591 (9.1 days).

The control seeds were sown as dry seeds. A separate control set was also taken in the normal day light, with seeds germinated to reach the stage of vernalized seeds. These second control seeds took 60 to 64 hrs. to show the stage of germination of vernalized seeds. The results of this trial showed that with the same stage of germination, vernalization induced an earliness of 3 days in C13 and of 7 days in Pb591. The effect of light treatments on the difference in the time taken for flowering between this second control and vernalized seeds will be investigated in the coming season.

TABLE II (a) and (b)

Effect of long duration of light on flowering

Light treatment	No. of days taken	Critical diff.	No. of days taken		Critical diff.
			C13	Pb591	
Normal day	72.2	1.04 @ 5%	64.8	74.4	1.82 @ 5%
18 hrs. "	46.0	1.40 @ 1%	40.1	52.3	2.42 @ 1%
24 hrs. "	39.2	..	32.5	44.3	..

* The normal day in the season ranged from 10½ hrs. to 11½ hrs. from sowing to flowering time.

Exposure to long duration of light hastened significantly (1%) the ear emergence; the change from normal day to 18 hrs. day showed an earliness of 26.2 days and that from normal to continuous illumination an earliness of 33 days; the difference from 18 hrs. to 24 hrs. was also significant, *viz.*, 6.8 days Table II (a). The early variety C13 showed significantly greater response than the late variety Pb591 under both the durations of light, *i.e.*, 18 hrs. (1%) and 24 hrs. (5%). There was, however, no significant difference in the responses of the two varieties between 18 hrs. day and continuous illumination Table II (b).

TABLE III

Interaction between varieties, long durations of light and low temperature treatment on ear emergence

Light duration	Vernalization	C13	Pb591	Critical diff.
Normal day	V	62.8	69.0	..
	C	67.0	79.8	..
18 hrs. day	V	37.8	47.8	2.55 @ 5%
	C	42.5	56.8	3.44 @ 1%
24 hrs. day	V	31.5	40.5	..
	C	33.5	48.5	..

Ear emergence represents the rupture of sheath of the terminal leaf by the growing ear. Under normal duration and 18 hrs. day light both the early variety C13 and late variety Pb591 responded significantly to vernalization, and earliness was much greater in late variety (10.8 days and 9.0 days) than that in the early variety (4.2 days and 4.7 days).

Under continuous light the early variety C13 did not show any effect of vernalization, while Pb591 showed significant earliness by 8 days.

The significant effect of long durations of light in inducing earliness in Indian wheats noted here is in agreement with the results of previous workers.^{1,2,3,4} But the effect of vernalization in inducing earliness in Indian wheats has not been reported by previous workers except Sen⁵ who reported it in late varieties. The present work indicates that both the vernalized wheats C13 and Pb591 flower significantly earlier as compared with the plants from untreated seeds of the type sown by the cultivators, but the response of the late variety Pb591 is greater. From the response of the two varieties to the low temperature seed treatment under different light durations (Table III) it is indicated that the effect of the low tempera-

ture seed treatment is significantly reduced with the increasing photoperiods, and in the case of the early variety C13 the effect is completely masked under continuous illumination.

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OIL OF CYPERIOL (CYPRUS SCARIOSUS)

The tree belongs to N. O. Cyperaceae, and it is known in Sanskrit as *Nagar Mustaka* and in Hindi as *Nagar Motha*. It occurs in damp places of Bengal, Pegu, U.P., and southern parts of India, common in Sunderban. The description of plant is given by Kirtikar¹ and also in *Wealth of India*.² The plant produces deep brown tubers with aromatic odour, which are used for medicinal purposes and the oil extracted from it as a hair tonic. Basu¹ mentions that steam distillation of tubers yield 0.075% to 0.080% of an essential oil with a pleasant odour.

The authors have found that the constants given by Basu do not tally with the constants recently determined by them. The oil was supplied by Messrs. Manaunlal Ramnarain, Perfumers, Kannauj. The yield of oil reported by them is 0.31% on the weight of tubers. The constants are:

Specific gravity at 20° C.	..	0.9898
Ref. Index at 20° C.	..	1.5130
Optical rotation	..	-9.14
Acid value	..	5.36
Saponification value	..	14.87
Aldehyde content	..	2.5%
Acetyl value	..	108.0

The oil has good fixative properties and has been found to replace patchouli oil partially.

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CORRECTION TO PREVIOUS NOTE

In the note,¹ 'Aegerita webberi on scale insects' should be corrected as 'Aegerita webberi on white flies'. The correction applies to the text throughout.

I am grateful to Dr. B. B. Mundkur for pointing out the error.

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LIFE-HISTORY OF SCHISTOSOMA INDICUM MONTGOMERY, 1906,—A COMMON BLOOD-FLUKE OF INDIAN UNGULATES

Schistosoma indicum is the commonest blood-fluke of domestic animals in India. It is associated with the nodulated hepatic cirrhosis in horses (Datta, 1933) and in sheep and goats (Rao, 1947), and possibly with 'Kumri' (Malikani, 1933), a disease of yet unknown etiology. The only report on the life-history of this blood-fluke is by Oo-Keh-Khaw, 1947, who found that a furcocercous cercaria obtained from *Indoplanorbis exustus* in Bihar proved on infection to a rabbit to be of *S. indicum*, but neither the description of the cercaria nor any detail of the experimental infection has been given. A systematic survey of the furcocercous cercariae infecting the common species of aquatic snails in Bareilly has been undertaken since July, 1949. During September, 1949, a type of apharyngeal, brevifurcous, non-ocellate, distome cercaria obtained from *I. exustus* on being administered to a clean kid proved to be that of *S. indicum*. Subsequently, another kid, a lamb and a guinea-pig were successfully infected with the same cercaria obtained from two more specimens of the snail. The kid, lamb and guinea-pig, all clean and two weeks old, were infected, the first two by the oral and the third by the cutaneous routes, with a large number of the cercaria from two specimens of *I. exustus*. The faeces of the lamb and the kid became positive for the eggs of the blood-fluke 52 and 62 days respectively after infection. The faeces of the guinea-pig remained negative for the eggs upto eight weeks after infection when it was autopsied and 376 males, 5 females and 91 pairs in copula were recovered from the portal and mesenteric blood and two mature and 24 immature males from the lungs. The female specimens from the guinea-pig were all ill-developed with no eggs

in the uterus. The kid on autopsy, 63 days after infection, yielded 536 males, 10 females and 17 pairs in copula from its mesenteric and portal veins and 36 males from its lungs. The lamb died 157 days after infection and was found to harbour 490 males and 35 females in its mesenteric and portal veins and 55 males in its lungs.

MORPHOLOGY OF THE CERCARIA OF *S. indicum*.

It is an apharyngeal, brevifurcous, non-ocellate, distome cercaria. The cercariae remain almost uniformly distributed in the water, their movements being in general similar to those of the cercaria of *S. spindalis* described by Soparkar (1921). They measure: body length 145-171 μ ; maximum width 43-55 μ ; length of tail stem 177-239 μ width of tail stem 23-32 μ ; length of furcæ 68-103 μ . The cercaria is fusiform, widest in front of the ventral sucker and tapering towards the ends, the anterior end being narrower. The anterior organ is highly developed and consists of anterior and posterior portions. Its length varies from 29-35 μ . The length of the conspicuous, dorsally situated head gland is $\frac{3}{4}$ ths of that of the anterior organ. The well-developed ventral sucker measures 16 μ in diameter and is situated in the anterior portion of the last quarter of the body length. Its cavity is Y-shaped. The surface of the ventral sucker is covered with spines which appear smaller and denser when it is in a dorso-ventral position, but when the larva lies laterally, which it frequently does under a coverglass, the sucker is projected and the spines appear larger and more prominent. The mouth is ventral and sub-terminal, situated at about $\frac{1}{5}$ th of the body length from the anterior end. The oesophagus is a narrow tube which dilates distally into a rather prominent cæcum at $\frac{4}{7}$ th of the body length from the anterior end. Its granular contents take up deep stain and show Brownian movements. There are five pairs of penetration glands (Fig. 1), filling up most of the space between the cæcum and the posterior end of the body. The contents of the anterior two pairs are coarsely granular and acidophilic and those of the three posterior pairs are finely granular and basophilic. However, in the cercaria from a snail which was kept in the laboratory for about two months the glands showed very little difference in granulation and staining reaction. The ducts are moderately thick, the width of the bundle of ducts of each side at the level of the middle region of the nerve mass being a little less than a third of the width of the nerve mass. The tip of each duct is swollen and capped by a hollow spine. There

are four pairs of flame cells in the body and one pair in the tail stem. The general arrangement of the excretory system is shown in Figs. 1 and 2. The genital rudiments are represented by a ball of cells situated ventrally behind the acetabulum. It has almost the same diameter as the acetabulum. The cells stain

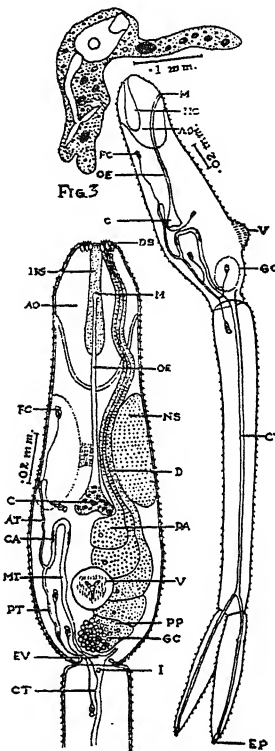


FIG. 1

FIG. 2

FIG. 1. Cercaria of *S. indicum*, ventral view showing along with other structures, penetration glands on one side and excretory system on the other.

FIG. 2. Cercaria of *S. indicum*, lateral view.

FIG. 3. Secondary sporocyst of *S. indicum*.

AO—Anterior organ; AT—Anterior collecting tubule; C—Cæcum; CA—Ciliated area; CT—Caudal excretory tube; D—Ducts of penetration glands; DS. Duct spines; EV—Excretory vesicle; FC—Flame cell; GC—Germ cells; HG—Head gland; I—Island of Cort; M—Mouth; MT—Main lateral collecting tube; NS—Nervous system; OE—Oesophagus; PA—Anterior penetration glands; PP. Posterior penetration glands; V—Ventral sucker; PT—Posterior collecting tube, deeply in vital stains. In specimens fixed in hot Bouin's fluid the genital rudiments become beautifully preserved and can be made out even without staining. The number of cells appears to be large and in one focus about forty or more could be counted. The nervous system is

represented by two prominent hemispherical masses situated in the middle third of the body. The length of each mass is slightly less than one-third of that of the body, and the maximum width is about $\frac{2}{3}$ ths of the width of that portion of the body. The two masses are joined in the middle by a narrow strand of tissue. The body, tail stem and furcæ are provided with rather prominent posteriorly directed spines.

The infected livers of snails are light yellow in colour and the lymph spaces are found packed with sporocysts and free cercariæ. The sporocysts (Fig. 3) are very thin walled and measure 300 to 714 μ in length and 29 to 70 μ in width. Generally, a sporocyst contains one mature cercaria at a time and numerous germ balls of various sizes. The maximum number of maturing cercariæ observed within a sporocyst was three.

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TURPENTINE OIL AND ROSIN FROM *PINUS KHASYA* (KHASHI PINE, DIENGKSEH OR SARAL)

Pinus khasya occurs not only in the Khasi Hills from where the name is derived, but also in other hills in the State of Assam. Hitherto this tree, which is a potential source of resin, has been exploited in the State of Assam to a limited extent, only for raising timber and fuel. The pine tree forms more or less pure forests.

Recently the Government of Assam appointed one of us (B. Saikia) for the development of Forest Industries in Assam and in this connection a study was undertaken to explore the industrial possibilities of oleo-resin from *Pinus khasya*. The oleo-resin was obtained from the

trees by making incisions in the wood and collecting the exuded resin flowing down the blaze over a metal lip and collecting in a conical earthen vessel or cup. The quantity of resin collected from individual tree varies according to the period of freshening of the cut, the weather and the size of the tree, being a maximum in the warm season. From experiments made so far, the yield per tree in the Khasi and Jaintia Hills (diameter 12 to 18 in.) had been estimated to be between 5 to 6 lb. per tapping season. The feasibility of utilising the Khasi pine trees for resin-tapping and subsequent processing, was never investigated in the past.

The oleo-resin from the Khasi Pine is generally semi-solid or viscous with a light yellowish to white creamy colour and a fine smell. Six samples of resin 100 g. each, from the Khasi Pine from different localities were examined. The samples contained some impurities in the form of dirt and wood-chips. The suspended water was drained out and the samples were individually subjected to steam distillation. The yield (average of six samples) of oil and rosin are given below:

TABLE I

Yield of turpentine and rosin from 100 gm. resin

Samples (100 g. each)		Average value
1	Yield of oil of turpentine g.	23.4
2	Yield of rosin g.	67.6
3	Suspended impurities g.	1.0
4	Moisture g. (by difference)	8.7

The oil and rosin obtained were further examined. The oil was found to be a colourless mobile liquid, highly inflammable and with a characteristic odour and showing the following properties of turpentine: Specific gravity (15.5° C.), 0.8640-0.870; refractive index,

TABLE II

Temperature range ° C.	Refractive index, 25° C.	Optical Rotation, 55.04 mm. tube at 20° C.	Specific Gravity 15.5° C.	Percentage distilled
1 100-50	.. ..	.. ..	.. ..	2.0
2 154-53	.. 1.4721	.. 5.7	0.8703	74.0
3 156-58	.. 1.4735	.. -8.8	0.8697	14.0
4 158-60	.. 1.4737	.. ..	.. ..	5.0
5 160 and above (residue, yellowish and sticky)	1.4885	.. ..	.. ..	5.0 (by difference)

1.4730-1.4760; optical rotation observed in 95.04 mm. tube (20° C.), -6.7° to -7.0° .

The rosin is a transparent golden yellow solid with the following properties: Specific Gravity (15.5° C.), 1.064 to 1.085; Saponification Value, 170.0 to 176.3; Acid Value, 166.6 to 173.4; Melting Point, 70° to 72° C.

The oil on further fractionation showed the characteristics given in Table II.

Our thanks are due to Mr. P. D. Stracey, Senior Conservator of Forests, Assam, for his interest in the work and to Major S. C. Dutt, Director of Public Health, Assam, for his permission to carry out the work at the Provincial Public Health Laboratory, Shillong.

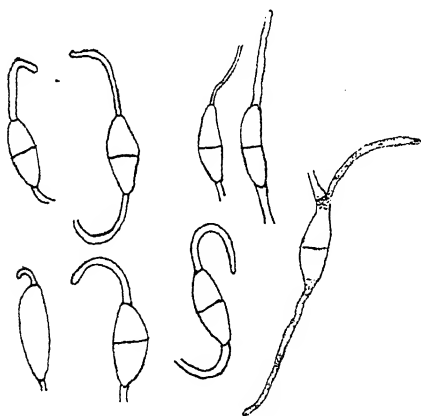
B. SAIKIA.

Prov. Pub. Health Lab., P. K. DAS.

Assam, Shillong, B. K. DATTA ROY.
February 1, 1951.

A HYPERPARASITE ON TWO SPECIES OF *KORDYANA* RAC

KORDYANA is represented at Bapatla by two species, *K. indica* Gäum. and *K. celebensis* Gäum. occurring respectively on *Commelina benghalensis* L. and *C. attenuata* Koen. It was observed that a number of bicellular, ciliate spores occurred in the hymenia of both the species. These were found to belong to a different fungus, apparently parasitic on *Kordyana*.



Monotrichum commelinæ conidian, one germinating; $\times 720$.

The hyperparasite was first observed in November, 1950, nearly a month after *Kordyana* had first been observed and conidia were more frequently encountered in December, 1950, and January and February, 1951. The conidiophores are hyaline, often curved and appear to arise individually from the substomatal hyphal stroma of *Kordyana*. They emerge through the stoma and bear apically one conidium each. The

conidia are distributed irregularly among the basidia of *Kordyana*. They are two-celled, elliptical, sometimes with one side flattened, smooth, hyaline, each provided with a hyaline, curved cilium at the apex. They measure $10-17.5 \times 4.0-6 \mu$. The cilium is upto 18μ long and 1.5μ wide. The conidia germinate in distilled water in 6 to 8 hours by giving rise to one germ tube from one or both ends. Sometimes the septum beneath the cilium appears to dissolve, the granular protoplasm of the upper cell collects at the base of the cilium and the latter elongates functioning as a germ tube (Fig. 1). Attempts to bring the fungus into culture by transferring germinating conidia to different media failed.

Gäumann¹ has described *Monotrichum commelinæ* on leaves of *Commelina benghalensis* associated with *Kordyana celebensis* Gäum., as the only representative of the genus. He has suggested that it is probably parasitic on the latter in a manner similar to species of *Tuberulina* on rusts. The fungus described above appears to be the same species though the spores have a slightly wider range of length. Its association with the two species of *Kordyana* seems to lend strength to Gäumann's suggestion regarding its parasitism. *K. indica* is a new host for the fungus.

Gäumann placed *Monotrichum* in the Mucedinaceæ. Clements and Shear² included it in the Melanconiales. Ainsworth and Bisby³ regard it as a genus of doubtful taxonomic position belonging to the Moniliales.

I am grateful to Mr. T. S. Ramakrishnan, Government Mycologist, Coimbatore, for valuable suggestions.

Agricultural College, K. V. SRINIVASAN.
Bapatla,
July 29, 1951.

1. Gäumann, E., *Ann. Mycol. Berl.*, 1922, 20, 257-71.
2. Clements, F. E., and Shear, C. L., *The Genera of Fungi*, 1931, p.198.
3. Ainsworth, G. C., and Bisby G.R., *A Dictionary of Fungi*, 2nd. Ed., 1945, p. 393.

STEMPHYLLIUM ILICIS ON LIVISTONA MAURITIANA WALL.

A CHARACTERISTIC leaf-spot of the garden palm *Livistona mauritiana* Wall was observed by the author in January this year. Subsequent surveys showed that the disease was prevalent in most of the nurseries and gardens at Lucknow and Allahabad. Out of a stock of 140 plants in the University Gardens, Lucknow, 56 plants were affected by this disease. They were kept under observation and it was found that

within a month the affected leaves were destroyed.

The earliest visible symptoms of the disease are etiolation and appearance of certain yellowish brown patches in the affected regions. These patches in due course take a definite oval or spherical form and are about $\frac{1}{2}$ -1 cm. They arise at regular intervals on the segments, mainly in the mid-portion and there may be 5 or 6 rows of these on each leaf. After some time the spots increase in size mainly in the longitudinal direction and this process leads to coalescing of the spots. In the later stages greyish black specks appear on these patches due to preponderance of conidia; finally perforations arise resulting in premature drying and withering of the leaves.

Microscopic examination of these spots showed conidiophores coming out through perforations in cuticle or through the stomata. In the sections hyphal ramifications could be seen all over but were mainly profuse below the epidermis.

Isolations were made from the infected parts under sterile conditions. Invariably pure monohyphal cultures of the fungus were obtained and the fungus was identified as *Stemphyllium ilicis* (Tengwall, 1924).

The fungus grows well on synthetic agar medium. It forms a striated light grey colony which in due course becomes sooty black and is about 1 mm. in thickness. In later stages the colony sometimes gets covered by a frayed cob-web like mycelium. Hyphæ are sub-hyaline, septate, branched and 2μ - 5μ in width. Conidiophores arise as side branches from the

hyphæ. They are olivaceous brown, septate, unbranched and 3.5μ - 5μ width. Distance between septa in the conidiophores is less as compared with that of the hyphæ. On the conidiophores several conidia are borne in botryose arrangement which generally get detached but their position can be marked by the crooked scars at short intervals on the conidiophores. Conidia are always borne singly and are rather variable in shape, depending upon the age. They arise as unicellular spherical bodies but later develop septations and become obclavate in shape. Septa are always transverse and may be 1-6 depending upon the age of the conidia. In colour they are buffy brown at first but later on become dark brown. In size they are 12μ - $43\mu \times 7\mu$ - 11μ .

These characters tally with the diagnostic characters of *Stemphyllium ilicis* as enumerated by Neergard.¹ As far as known to the author this is the first record of this fungus on palms.

It, however, remains to establish the actual relationship of the fungus with the host which will be possible after performing infection experiments in the coming rainy season.

My sincere thanks are due to Prof. S. N. Gupta for his valuable guidance.

Dept. of Botany,
University of Lucknow,
Lucknow,
July 10, 1951.

M. KAMAL.

1. Neergard, P., Danish spp. of *Alternaria* and *Stemphyllium*, p. 321. Einar Munksgaard, Publisher, Oxford University Press, London, 1945.

DR. PATRICK C. YOUNG

DR. PATRICK C. YOUNG succeeds Dr. Alexander Wolsky in Delhi as Head of the UNESCO Science Co-operation Office for South Asia.

From 1934-39 Dr. Young was with the Imperial Chemical Industries as Plant Manager and Technical Officer in the production of thermosetting plastics, and in developing plastic applications in a great number of British industries. During the War he held executive positions for three years as Chief Engineer and Technical Manager in enterprises associated with aircraft production before returning to the field of plastics as Manager of the group of works

of the then largest self-contained productive enterprise in Britain in the Plastic Moulding Trade.

In January 1948, on the recommendation of the British Chancellor of the Exchequer he was invited to act as Consultant to the United Nations Economic Commission for Asia and the Far East, and participated in this capacity in the deliberations of the Working Party on the Industrial Development of Asia and the Far East which reported to the Ootacamund Conference of ECAFE in that year.

We wish him a very happy and successful tenure of office.

REVIEWS

Theory of Groups and Its Applications to Physical Problems. By S. Bhagavantam and T. Venkatarayudu. II Edition. Andhra University, Waltair, 1951. Pp. vii+277. Price Rs. 20.

The popularity of the book is indicated by the fact that the first edition has become out of print in less than three years. The new edition is practically a reprint of the first but for some minor alterations and additions. Written specifically to meet the needs of physicists, the book rightly emphasises the results of the theory and the methods of applying it to various problems, in preference to mathematical rigour. Proofs of theorems are relegated to appendices, where the interested reader can find them, thus keeping the treatment in the main chapters coherent and continuous.

Group theory is finding more and more application in various branches of physics—Crystal Symmetry, Crystal Physics, Band Spectra, Molecular Vibrations and Quantum Mechanics—and all these aspects are considered in this book. The authors were the pioneers in this country in the application of group theoretical methods to the study of Raman Spectra. Most of the examples in this field have therefore been drawn from the original investigations of the authors. One only regrets that the more recent work of the French school has not been touched upon in this new edition.

Printing is excellent, although a few errors are occasionally found, e.g., 'Right' for 'Rigid' in p. 65, l. 17 and Ξ for Σ in p. 79, l. 21. But the binding and get-up are not up to the mark; these should be improved even at the risk of increasing the price.

Die Chemische Affinität: By Egon Widberg. (Walter De Gruyter & Co., Berlin). Pp. 254+xii, 36 Figures. Price DM 24.

The volume under review is an introduction to the driving force of Chemical Reactions and is stated to be based on a course of lectures in the University of Munich. The volume is divided into three main sections each devoted to one of the Laws of Thermodynamics. The short first section gives an elementary account of reaction heats and of Hess' Law. A consideration of the Free Energy change in chemical reactions is found in the second section covering about 100 pages. The mechanical and elec-

trical work performed by chemical reactions is considered and the treatment covers normal electrode potential, decomposition potentials and overvoltage. At each stage suitable examples from technical and academic angles are chosen to illustrate the points considered. The Born-Haber cycle is introduced and in the last section the third law and entropy changes are discussed. The treatment on the whole is very elementary and at best useful to a beginner. Considering the elementary treatment, the language in which the volume is written and the relatively high price, it is not likely to be of any great use in this country. The get-up and printing of the publication is very good.

S. V. ANANTAKRISHNAN.

South African Scenery: By Lester C. King. (Oliver and Boyd, London and Edinburgh), 2nd Edition, 1951. Pp. xxxii+379. One coloured map, 266 plates, 79 text-figures. Price 45 sh. nett.

One of the earliest books on scenery in relation to geology was from Archibald Geikie's powerful and prolific pen—the *Scenery of Scotland*, published half-a-century ago. But in recent years several excellent books have come out from America, generally very finely illustrated. As examples we may cite the books on Geomorphology by Van Engeln and Lobeck.

The book under review concerns itself with South Africa though there are fairly frequent references to parts of East and Equatorial Africa. It is of interest not only to the inhabitants of Africa but also to others who wish to know something of that continent, its geology, geographical evolution, land forms and scenic interests.

The book is divided into 21 chapters. Commencing with a general introduction of Geomorphology it proceeds to treat of weathering; development of rivers, hill slopes, erosion cycle; work of wind and the arid cycle; work of groundwater, the sea, glaciers and volcanoes; movement of land, uplift and depression. The four closing chapters deal with the geomorphology of the several natural regions of Southern and Equatorial Africa.

Written by a Geologist (the author being a Teacher of Geology in the University of Natal), the causes and effects of natural geological processes are adequately explained but without making the book too geological in treatment.

The reader would find an excellent treatment of the erosion cycle and particularly soil erosion, its effects and its remedies. This last topic has now caught the imagination of even politicians, and civil engineers. The author has something to say about the destructive activities of man in this regard: "Some of the Union's finest forest and agricultural lands have been ruined by overstocking and careless tillage, deforestation has left a trail of destruction in more than one locality, while his civilized tinkering with the flow of rivers, the action of the sea and erosion generally, have often rebounded more to his surprise than to his credit". The author states that the destruction of the vegetal cover in Northern Nigeria and surrounding areas has resulted within 200 years in the depopulation of a country as large as the Union of South Africa. The wrong practices followed by both the white and black man alike in the matter of the use of land have created the South African desert, which is apparently gradually spreading out.

In the chapter on the work of the wind, desert features are well described. For the fixation of drifting sand dunes and of moving masses of sands along sea coasts, certain plants such as *marram grass* have been found to be useful. After growing grass as the first step, later fixation can be done by wattle or Port Jackson willows which have been used in South Africa.

We learn from this book the interesting fact that man's nearest relation in the animal kingdom, namely the baboon, is also a destructive geological agent. It appears that troops of baboons roam about the country turning over an enormous number of stones, rolling them down the hill side, in search of lizards and scorpions which apparently form articles of their food. We also learn that white-ants build ant-heaps 15 ft. high and 40 ft. across at the base, at intervals of a few yards, in parts of Northern Rhodesia and Congo. Judging from this the white-ants must be more destructive in South Africa than in our country.

An interesting chapter (Chapter XVIII) deals with the evolution of the morphology of South Africa and this is treated as a succession of erosion cycles. The four major land-surfaces are called *Gondwana*, *African*, *Victoria Falls* and *Congo*, which are related to such cycles. Each of these is found to constitute a rather complex surface which might perhaps require some modification as our geological knowledge of the Continent grows.

The book is well illustrated by as many as 266 plates, many of which are interesting as

well as instructive. It is lucidly written and can be read with profit not only by geologists and geographers but also by others who wish to learn something of the surface of the earth on which we live. The author and the publishers should be congratulated in bringing out the second edition of this fine book.

M. S. KRISHNAN.

Six-Membered Heterocyclic Nitrogen Compounds with Four Condensed Rings. By C. F. H. Allen and Five Collaborators. Interscience Publishers, New York, 1951. Pp. 358, 7 illustrations and 40 tables. Price \$10.00. Special subscription price: \$9.00.

The second volume in the series "The Chemistry of Heterocyclic Compounds" is a great improvement on the first, which left the impression that too heavy a price was being charged for too little material. In view of the large number of monographs in which heterocyclic chemistry is to be treated in the Interscience series, and of the fact that two volumes of another series on heterocyclic compounds have appeared (Wiley, New York, 1950), it is possible only for institutional libraries to purchase the series; and many libraries with limited resources will have to make a choice between the two. However, the present volume will be a most valuable addition to the private library of any worker in the heterocyclic field, although it is limited in scope to the seven ring systems consisting of four fused benzene rings in which a methine group (and not a carbon atom common to two rings) is replaced by nitrogen. The book is a model of scholarship; it is comprehensive and clearly written; the references, particularly to patent literature, are exhaustive. In pleasing contrast to Morton's *Chemistry of Heterocyclic Compounds* (McGraw-Hill, 1946), equations and formulæ are very clear and readily understandable. Nomenclature and numbering are systematic; in addition to the aza names which are generally used and shown in bold type against each ring system, Chemical Abstracts and other names and the Ring Index number are given. Each section concludes with a table in which nearly all the reported compounds of the given type are listed, together with the physical properties and the sources of information.

The importance in the drug and dyestuff industries of the heterocyclic skeletons with which the book deals is somewhat exaggerated; but their fundamental interest is beyond question, and the treatment is so excellent and stimulating that the book can be read and repeatedly used with profit by organic chemists

concerned with widely different problems of degradation and synthesis of naturally occurring substances, biologically active compounds or synthetic dyes. Pointed attention is drawn in every chapter and section to gaps in our knowledge; passages such as the following are typical: "The few known compounds which possess the 7H,1-azabenzanthrene nucleus are, in fact, 1-azabenzanthrones (III).....The only available source of information on these compounds is in a series of patents granted to the I.G. Farbenindustrie to cover their use as dyes or dye intermediates. In view of this, many of the structures are unknown, or not definitely established; on the whole, descriptions of the compounds are sketchy" (p. 204). "There are four hundred ninety-five possible arrangements for the tetrazabenz(=)anthracenes, but only two have been prepared." The literature is reviewed critically with an emphasis on the incompleteness or unsatisfactory character of data and on uncertainties in the structures assigned to compounds.

The symbol at the back of the book is not happily chosen, since it represents the fusion of four rings, each of which contains nitrogen.

The literature has been covered through 1950, but a few omissions have been noticed. Bally showed that his "benzanthronequinoline" had an angular orientation with reference to the anthrone ring, but not that the compound was 5(N):6-pyridinobenzanthrone; its constitution as 8:9(N)-pyridinobenzanthrone (I) has been proved by its synthesis from 9-aminobenzanthrone (*Proc. Indian Acad. Sci.*, 1950, 32A. 39). It is stated in p. 81 that the structure (I) for Bally's compound has "since been confirmed", but no reference is cited.

The Colour Index numbers cited for Alizarin Green S, Blue S and Grey SD are erroneous, but they coincide with the Schultz numbers. "Naphthoylpicolinic acids" in p. 6 should read as "naphthoynicotinic acids". Quaternary ammonium salts are occasionally shown with five covalent bonds. Why should an aldehyde be called a "carboxaldehyde" (p. 58)? "Sulphate" in p. 65, line 13, should be "sulphite". Are complex molecules derived from 2-keto-3-azabenzanthrones "commonly employed as vat dyes" (p. 219)? After the lengthy discussion in p. 102-07 and the reference to de Diesbach's 1949 work in p. 111, Posner's 1926 structure is given in p. 222; incidentally, what is the difference between structures (XXX) and (XXX a)? Formula (XXX b) in p. 102 contains a trivalent carbon atom and one too many hydrogen atoms. Alkylation of 3-azabenzanthrone is much more likely to take place in the 4- than in the 5-

position (p. 222). Compound (XVI) will not have vat dyeing properties; the vat dyes mentioned in the patents under reference are prepared by condensing the bromoazabenzanthraquinone (XVI) with 1:5-diaminoanthraquinone, etc.

It is stated in p. 21 that "the only syntheses of the 1:3-diazanaphthacene ring system appear to be those described in two related I.G. patents"; an intermediate for Indanthrene Green 4G is 4-chloro-2-phenyl-1:3-diazanaphthacene-6:11-quinone (B.I.O.S. Report, 1493); see also I.G., B.P. 476,599; 494,168).

Some economy in the cost of printing might have been effected by not repeating structural formulæ such as (VI) in pp. 4, 5, 6; (VIII) in p. 64; (IV) in pp. 211, 216; (XIV) in pp. 214, 215; (XXXIV) in pp. 224.

K. V.

Hollman Organic Chemistry. By J. P. Wibaut, translated from the Sixteenth Dutch Edition by S. Coffey. (Elsevier Publishing Company, Cleaver-Hume Press, Ltd., 42-a, South Audley St., London W.I.), 1951. Pp. xiv+660. Price 15 sh.

Since the appearance in 1930 of an English edition of Hollman's *Textbook of Organic Chemistry*, several fundamental advances and far-reaching developments have taken place in the field of organic chemistry. The task of adapting and modernising that familiar book, taking especial care to retain its original character and appeal of treating the subject-matter from the standpoints of organic chemical theory of structure and physicochemical aspects, is hard, particularly because of the length of the present publication and Prof. Wibaut has indeed been largely successful. Nevertheless, necessary additional space may well have been devoted to more detailed formulation of the Electronic Theory, its scope and limitations and the interpretations of many of the organic chemical reactions otherwise adroitly handled and to more information about the biologically important penicillins, other antibiotics, hormones and vitamins. However, the present edition will constitute an excellent textbook for chemistry students of the B.Sc. level of most Indian Universities. Its advantageous use is indicated to biological and medical students and to research workers in fields other than organic chemistry.

There are a few misprints and errors of oversight or of typographical nature. The deletion of 'here' from l. 8 on p. 5 and substitution of 'abandoning' for 'abandonment' in l. 10 of same page and 'ionic' in place of

'ionogenic' in l. 33 of p. 6 will surely be improvements. The statement that 'nitrogen escapes as such' in lines 19-20 on p. 8 obviously needs modification. Numbering of formulæ at the top of p. 371 as I-IV has been omitted as also "c" in ferric and 'ous' in ferrous in l. 21 and 'h' in diphenylbenzoquinone in l. 25 of succeeding page, 'i' in 'material' in l. 16, p. 386, oxide in l. 13, p. 377, 'combating' in l. 38, p. 386, 'acetyl' in l. 18, 'dione' in l. 19, and 'produced' in l. 21 of p. 513 are mis-spelt. The expressions "Sulphapyridine is used in medicine against infectious diseases caused by streptococci (only). It has a similar action to Prontosil and nicotonic acid and nicotinamide are of importance in biochemistry" certainly need obvious revisions. These are minor criticisms not seriously militating against the scope and usefulness of this characteristically well-printed Elsevier publication.

S. RAJAGOPALAN.

Papain. By M. L. Tainter and others. *Annals of the New York Academy of Sciences*, Vol. 54, New York, 1951. Pp. 154. Price \$3.00.

In spite of the fact that Papain is one of the long-known and widely employed enzymes, published literature on the subject, except for references to the enzyme in books on Enzyme Chemistry, is surprisingly meagre. The sterling—Winthrop Research Institute, which is particularly interested in this scientifically interesting and commercially important enzyme, has taken an enlightened interest in this subject and arranged to "send one of its staff into the field to study optimum conditions of collecting and drying the latex and possible means of stabilising the potency of the resultant powdered Enzyme. These studies led to extended consideration of available methods of assay and finally to the digestive activity *in vitro* as well as *in vivo*". The above studies together with a very comprehensive, up-to-date and critical review of the literature on papain, have been presented in the *Annals* (Vol. 54, pages 143-296). Photographic reproductions of papaya plantations, the methods of tapping and drying the latex which illustrate the pamphlet, enhance the usefulness of the volume. The annual production of the crude enzyme has been estimated at 500 tons and there is a good prospect of increasing this output in many of the tropical countries including India and Ceylon. In addition to the enzyme, the plant as a source of valuable and nourishing fruit, is well recognised. The volume under review has brought together information pertaining to all these scientific and economic aspects of the subject. It will be found

an invaluable and inspiring guide both to the scientist and to the manufacturer interested in the subject of papain.

The Fishes of the Indo-Australian Archipelago.

Volume IX. (Percomorphi concluded; Blennioidea). By L. F. de Beaufort with the collaboration of W. M. Chapman. (E. J. Brill, Leiden), 1951. Pp. 1-xi+1-484 with 89 illustrations.

The students of fish and fisheries of South-East Asia and of the adjacent countries are, no doubt, fully familiar with the very famous work on Indo-Australian Fishes by the two well-known Dutch Ichthyologists, Prof. Max Weber and Prof. L. F. de Beaufort. The senior author, who had planned this work and devoted more than 25 years of his long and laborious life to its advancement, died on February 7, 1937, when only 7 volumes of the series had been published.* The eighth volume, which was published during the War, was dedicated to the memory of Prof. Max Wilhelm Carl Weber by Prof. L. F. de Beaufort. The next volume has now appeared after a lapse of eleven years. It is, therefore, a great event in the history of ichthyology in this part of the world.

As explained in the Introduction, the material for it had been prepared in the War years 1941-44. There have, however, been several reasons for the delay in its publication. Firstly, printing was difficult during the later periods of the War and after the War, the Press has been crammed with more urgent work. Secondly, the author, having reached the age limit of 70, had to retire as Professor and as Director of the Zoological Museum at Amsterdam. Thirdly, the notoriously difficult genus of *Salarias* (Blenniidae) had to be entrusted to Professor W. M. Chapman for revision, who has contributed the material for pages 243 to 355 of the volume and is thus the author of the description of the family characteristics of the Blenniidae, of the key of the family, of the descriptions and synonymy of the first eight genera of the Blenniidae and of the descriptions and synonymy of the species belonging to these genera. In acknowledging the help of Professor Chapman, the author very graciously states that 'As a consequence, this part of the volume is far superior to what I could have written'. The ichthyologists of the Indo-Pacific region are thus grateful to Professor Chapman 'for having given this work priority over other urgent activities'.

* The dates of publications of the various volumes are as follows:—Vol. I, 1911; Vol. II, 1913; Vol. III, 1961; Vol. IV, 1922; Vol. V, 1929; Vol. VI, 1931; Vol. VII, 1936; Vol. VIII, 1940, and Vol. IX 1951.

As usual, this volume is well printed and got up, and the publishers are to be congratulated on the excellence of the series.

Professor L. F. de Beaufort disclosed the plan of the remaining volumes to the reviewer as early as March 15, 1948. The text of the tenth volume on Gobioidae by Dr. F. P. Koumans has been ready for some years and is now likely to be published soon. Volume XI will deal with Scleroparei, of which Hypostomides (*Pegasi-formes*) had already been worked out in 1948. *Discocephali*, *Xenopteri*, *Pediculati*, and perhaps the *Opisthomi* will also be included in this volume. Volume XII will contain an account of the *Plectognathi*, while the last Volume XIII will deal with Rays and Sharks. Dr. Koumans had started work on the Rays and Sharks, but now that he has given up ichthyological studies, work on this volume may have to be undertaken by Dr. de Beaufort himself.

It is a matter of great pleasure to learn that the young Republic of Indonesia has decided to promote the issue of this meritorious publication in the same way as has been done previously by the Dutch Government. For this enlightened policy, ichthyologists all over the world are deeply indebted to the Government of the Republic.

S. L. HORA.

Methods of Vitamin Assay. Second Edition.

Prepared and Edited by the Association of Vitamin Chemists, Inc. (Interscience Publishers, Inc., New York), 1951. Pp. xviii+331. Price \$5.50.

Assay of the vitamins constitutes a very essential and vital part of analytical biochemistry. The difficulties and complexities which confront the analyst, particularly those who have to deal with natural products, are well known to investigators in the field. Workers in different laboratories have, in the course of overcoming these difficulties and simplifying the complexities, have from time to time, arrived at improvements in vitamin methodology directed towards the attainment of greater specificity, accuracy and reproducibility. Such painstaking attempts have been carefully chosen, critically evaluated and their worthiness for adoption as standard procedures, appraised by the Association of Vitamin Chemists Inc. Agreement on the standard methods has been reached only after a series of independent trials in different laboratories. The methods described in this volume are thus "the result of the pooling and interchange of information on analytical techniques and thus represent the combined knowledge and experience of many persons".

The second edition of this volume reflects increasing experience with vitamin methodology. "It includes assays for several members of the Vitamin B Complex for which methods were not described in the first edition, namely, pantothenic acid, pyridoxine, folic acid, biotin, Vitamin B₁₂ and a chemical analysis for niacin." The volume has been brought up-to-date by incorporating suggestions and reports of experiences from different laboratories. The Association wishes once again to invite comments, suggestions, recommendations, etc., in order that improvements in vitamin methodology may be continued. The volume is indispensable not only for the analyst but also to every research worker. The Association of Vitamin Chemists has earned the gratitude of all investigators interested in vitamin methodology for organising the publication of what may deservedly be regarded as the most authoritative volume on the assay of vitamins.

The Chemistry and Technology of Food and Food Products. Edited by Morris B. Jacob. 3 Vols. (Interscience Publishers Inc., New York), 1951. Vol. I. Pp. xxv+832. Price \$12.00.

The present review relates to Volume I only. This volume is divided into three parts. Of these, Part I on 'Fundamentals' is the same as in Volume I of the first edition. Two new parts added are, Part II on 'Unit Operations and Processes' and Part III on 'Sanitary and Quality Control'. Part I forming more than half of the volume is a repetition of material better read in any textbook of Biochemistry. It is not necessary to repeat here the criticism of the book, for, it is already covered in a review of the first edition* of the book. We can only hope that in later editions, among other things, at least a better edited introductory chapter will be presented in the interests of this treatise as an occasional reference work.

The paper used for printing the present edition is, however, of a better quality than the one used in the previous edition and this is, perhaps, one of the factors for its enhanced price.

S. N.

* *Journal of Scientific and Industrial Research*, 1946, 5, 131, by the present reviewer.

Books Received

Stainless Iron and Steel, Vol. I. By J. H. G. Monypenny. Chapman & Hall, 1951. Pp. xi+523. Price 45 sh. net.

The Pectic Substances. By Z. I. Kertesz. Interscience Publishers, Inc., 1951. Pp. xvi+628. Price \$13.50.

Radio-Chemical Studies—Fission Products, Books 1, 2 and 3. Edited by Charles D. Coryell & Mathan Sugarman. McGraw-Hill International Corporation, 1951. Pp. xxx+518, xvi+519 to 1315 and xx+1316-2086, respectively. Price \$18.50 per set.

The Invertebrates, Vol. III. By Libbie Henrietta Hyman. McGraw-Hill Book Corporation, 1951. Pp. viii+572. Price \$9.00.

The Chemistry of Uranium. By Joseph J. Katz and Eugene Rabinowitch. McGraw-Hill Book Corporation, 1951. Pp. xxii+610. Price not given.

Experiment in Dental Care, W.H.O. Monograph No. 4. By J. J. Fulton. W.H.O. Palais des Nations, Geneva, 1951. Pp. 87. Price \$1.00.

Elementary Genetics. By Wilma George. Macmillan & Co., 1951. Pp. iv+172. Price 10 sh. 6 d.

Adhesion and Adhesives. By N. A. Debruyne and R. Honwink. Clever Hume Press Ltd., 1951. Pp. xvi+517. Price 70 sh.

The Enzymes, Vol. II, Part I. By J. B. Sumner and K. Myrback, Academic Press, Inc., 1951. Pp. xii+790. Price \$14.80.

The Fundamental Aspects of Lubrication. Edited by Roy Waldo Miner and 14 others. New York

Academy of Sciences, 1951. Vol. 53, Art. 4. Pp. 753-994. Price \$4.00.

Specific Methods of Analysis. By S. E. Q. Ashley and 13 others. New York Academy of Sciences, 1951. Vol. 53, Art. 5. Pp. 995-1118. Price \$2.50.

Annual Review of Biochemistry, Vol. 20, Annual Rev. Inc., 1951. Pp. 648. Price \$6.00.

Mathematical Engineering Analysis. By Rufus Oldenburger. Macmillan & Co., 1951. Pp. xiv+426. Price \$6.00.

Elementary Calculus. By M. Lakshmanamurthi. M/s. Rao Brothers, Guntur, 1951. Pp. viii+207. Price not given.

Science in the School Garden. By Mary A. Johnstone. Macmillan & Co., 1951. Pp. xiv+176. Price 4 sh. 6 d. net.

The River Mathematics. By A. Hooper. Macmillan & Co., 1951. Pp. 370. Price 18 sh. 6 d. net.

The Oxide-Coated Cathode, Vol. 2. Physics. By S. Wagener, Chapman & Hall Ltd., 1951. Pp. xiv+311. Price 42 sh.

Surface Chemistry of Solids. By S. J. Gregg. M/s. Chapman & Hall, 1951. Pp. ix+297. Price 30 sh.

BUILDING RESEARCH CONGRESS-1951

THE BUILDING RESEARCH CONGRESS, 1951, sponsored jointly by the learned societies and professional institutions of Great Britain, the Department of Scientific and Industrial Research and the Ministry of Works, was held in London from 11th to 20th September, 1951. In India, the large influx of refugee population, the alarming increase in birth rate that is taking place and the increasing trend of the villager to settle down in towns, have all combined together to create acute housing shortage in the towns. The housing problem has become gigantic in magnitude and its solution urgent. The Congress is therefore more than of ordinary interest to us in India. The summaries of the papers which have been received indicate the fine fare one can get at the Congress.

The papers have been classified under three divisions. Those under Division One deal with the influence of mechanisation and prefabrication on techniques and cost of building, the influence of modern research on structural design and on the influence of modern soil studies on the design and construction of foundations. Papers on prefabrication of houses will be helpful in evolving more economical and quicker methods in our projects. Our experience of these

projects have not been so far happy. Papers on pre-stressed concrete and shell construction ought to aid in achieving greater economy in the use of steel, those in the new fields of research on the structural use of glued laminated timber and of light alloy sections are to be welcomed because of the increasing activity and interest shown in their use, in recent years. Papers on soil mechanics are a good contribution to our knowledge of this modern science. Division Two deals with papers on research done recently in building materials. The papers on 'Weathering and Durability of Building Materials under Tropical Conditions', and those pertaining to manufacture of bricks, making good quality concrete, using plywood as a building material and on burning and shaking lime are of particular interest to builders here in India. Papers on "the Acoustics of Auditoria and Studios", ventilating and lighting of buildings and factories, and problems pertaining to the design of three specific types of buildings (hospitals, factories and schools) have been clubbed together under Division Three. Papers on the design of hospitals, factories and schools promise to be of more than ordinary interest to designers and architects.

N. S. G.

SCIENCE NOTES AND NEWS

International Standards Meetings

The Indian Standards Institution will participate in the meetings of a number of technical committees of the International Organisation for Standardisation (ISO), to be held in London and on the continent during October and the next two months. Dr. K. L. Moudgill, Deputy Director (Chemicals), will represent the Institution at these meetings.

C.S.I.R. News

C.S.I.R. News, Vol. 1, No. 1 of which has just now appeared, seeks to convey information relating to the activities and achievements of the various organisations and institutions functioning under the auspices of the Council of Scientific and Industrial Research, India.

Mr. K. Ramiah

Mr. K. Ramiah, formerly Director, Rice Research Institute, Cuttack, has been appointed Rice Consultant to the Food and Agricultural Organisation of the United Nations.

Rome Microbiology Congress

An International Congress on Chemical Microbiology was recently held in Rome, when the new international centre for chemical microbiology was also opened. The centre, the only one of its kind in the world, will be directed by Professor Chain, F.R.S., and 15 research scholarships are being provided by the World Health Organisation.

Research on Solar Radiation

During the past few years the Australian Division of Radiophysics has studied the intensity of the radio waves from the sun, on the following wave-lengths: 3, 10, 25, 50, 300 and 500 centimetres. The Division successfully developed the technique of using spaced receivers, during an eclipse, to determine the position of high emitting areas on the sun. As a result of these observations, and of theoretical studies based on them, it is now possible to recognise a base level of radiation over the wave-length

range from one centimetre to four metres. This radiation is due to thermal emission from the hot gases of the solar atmosphere. Theoretical studies have enabled the investigators to use the radio results to estimate the normal temperature and pressure of these gases at various heights above the visible surface of the sun.

Dr. S. S. De

Dr. S. S. De of the Indian Institute of Science has left for Bangkok as Regional Nutrition Officer, Asia and South-East Regions of the F.A.O.

Nuclear Physics Plan for Europe

The creation of a European Regional Laboratory for Nuclear Physics was under further consideration at the Sixth Session of the UNESCO General Conference. The idea has been under study since the 1950 meeting, when approval was given to the setting up of such regional centres, as proposed by Professor Isidor Rabi, of the U.S.A.

Flying Spot Microscope

A "flying spot" microscope which is able to scan, magnify, measure and count about a million minute particles, such as brain cells, per second, is described in the report of the Nuffield Foundation for 1950-51, issued recently.

The instrument uses a televiser, focussed through an ordinary microscope reversed, to scan the specimen in a series of lines by means of a minute and brilliant spot of light. A photo-electric cell converts the spot's messages into electric signals, which are amplified and converted into a display on a television-viewing screen three feet square. It is believed that the new technique may revolutionize the present primitive methods of counting and measuring cells in microscopic examination.

CORRECTION TO PREVIOUS NOTE

VOL. 20, No. 1, p. 38.

In the note on "Studies on Ion Exchange", Figs. 1 and 2 are to be interchanged. Also, in Table I, $10^3 \times m$. eq. must read as m. eq.

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Curr. Sci., 1950, 19, 296

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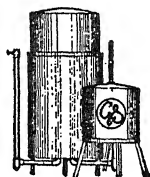
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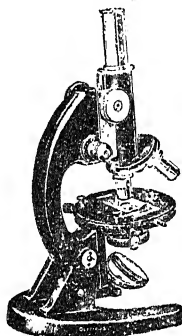


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Current Science

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SCIENTIFIC RESEARCH AND INDUSTRIAL DEVELOPMENT

THERE are various ways in which science can be brought to influence industrial development—by direct contact between private firms and university scientists, by the work in Government-sponsored laboratories or by the research associations of industrial groups themselves. While it is desirable that scientists in the universities should act as advisers to industrial concerns, the universities should mainly be concerned with fundamental research. Similarly, one of the functions of the Government laboratories would be to explore the possibilities of industrial application of our natural products, while the further adaptation of these processes to large scale manufacture and problems arising from them should properly be studied in the research laboratories of industrial firms themselves.

Unfortunately, there seems to be little recognition of the necessity for research in many of the industrial concerns in our country to-day. Apparently, this complacency on the part of our industrialists is not entirely absent even in a much more advanced country like Great Britain. In his book entitled "The Neglect of

Science",* Professor F. E. Simon of the University of Oxford, draws attention to the backwardness of British Industry in this respect compared to other countries like Switzerland and the United States of America.

Analysing the causes of Britain's industrial backwardness, Professor Simon traces it rightly to the lack of higher technological education of the level attained for instance in the Technische Hochschule at Zurich or the Institutes of Technology at Massachusetts or California. Emphasizing the indispensable rôle played by engineer-scientists as liaison between the fields of fundamental research and industry, he deprecates the fact that the technical education of creative engineers and applied scientists is at present mainly left to the rather small engineering departments attached to the universities. "While these may be suitable for the education of technicians—though even in this respect they do not compare too favourably with their opposite numbers abroad—they are wholly unsuitable for

* *The Neglect of Science*—Essays Addressed to Laymen by F. E. Simon, F. R. S., Basil Blackwell, Oxford, 1951.

educating engineers of the type with which we are concerned here. Hardly any of these colleges carry out any research worth the name, and this alone is enough to show that they cannot have people on their teaching staff really able to supply proper training in the subjects." This may be compared with the original statement regarding the four years' under-graduate course in science at the California Institute of Technology, which says: "Its purpose will be to provide a college education which, when followed by one or more years of graduate study, will best train the creative type of scientist or engineer so urgently needed in our educational, Governmental and industrial development. . . . In all the departments of the Institute, research is strongly emphasized, not only because of the importance of contributing to the advancement of science, but because research work adds vitality to the educational work of the Institute and develops originality and creativeness in its students".

In the light of the above, it is to be earnestly hoped that at least the newly established Institutes of Technology would strive to maintain such a standard of instruction and devote themselves to the training of engineer-scientists, who would play a notable part in the industrial progress of our country. However, one has to realize, as Prof. Simon says, that "it is not enough to create such an organization; it must also have the full support of industry. Unfortunately, one gets the impression that many industrialists are not fully awake to this point. This is perhaps due to the fact that on the boards of our companies we have no proper representation of scientists or engineers".

Besides taking early steps to reform the technological education in this country on the lines indicated above, it is eminently desirable, if only as an act of enlightened self-interest of long range utility, that our industrialists should create endowments of the nature of the Rock-

feller Foundation and the Carnegie Institution, where fundamental research can be carried out without much disturbance. In the words of Prof. Simon, "Since people and Government are very often interested only in the fairly near future, the question of giving adequate support to fundamental research has hardly ever received the attention it deserves, and the general public in particular, knows little about what is to be done".

We believe that there is a great opportunity here for private enterprise, which should not be lost sight of. This is especially to be desired because official bodies, however broad-minded, have a tendency to lay the stress on particular fields of research, with consequent detriment to all the other branches in which scientists may specially be interested. Also, there can be no greater stultifying influence upon pure research than the feeling that *results* are awaited by someone. It is easy enough to get plenty of results by choosing a suitable field—but this is not how progress is made in science.

Finally, some people may ask why, when fundamental research published in one country benefits industrial development all over the world, is it necessary to have fundamental research in all the countries? Why not leave it—especially in times of financial stress—to the richer countries?

Such a negative attitude, it is needless to point out, would be disastrous for any country which adopted it. Quite apart from the question of providing satisfactory education for the practical or applied scientists, we must remember that the scientific community is a living one with an equilibrium between different types of people and different types of research. It is, therefore, impossible to neglect the fundamental aspects of research without seriously affecting the onward march of science, on which industrial development ultimately depends.

NOBEL PRIZE FOR MEDICINE—1951

DR. MAX THEILER, who has been awarded the Nobel Prize for Medicine this year, was born in S. Africa in 1899. After his training in the London School of Tropical Medicine he worked at Harvard, in the Department of Tropical Medicine. It was there that he developed his work on the susceptibility of white mice to intra-cerebral inoculation of

yellow fever virus. Later, Dr. Theiler moved to the International Division of the Rockefeller Foundation, New York, where he made the discovery of the innocuous nature of 17D sub-culture of the Asibi strain of yellow fever. This strain is widely used for immunizing against yellow fever.

THE PHYSICS AND CHEMISTRY OF LUBRICATION*

THE basic laws of friction have been known for a long time. In fact, Leonardo da Vinci (1452-1519) wrote: "Friction produces double the amount of effort, if the weight be doubled" and "The friction made by the same weight will be of equal resistance at the beginning of the movement, although the contact may be of different breadths and lengths". The laws were rediscovered by the French Engineer, Amon-ton, in 1699, and are generally known by his name.

Leonardo da Vinci also made a number of observations on friction and some of them are significant in the light of the latest studies. He wrote, "All things and everything whatsoever, however thin it be, which is interposed in the middle between objects that rub together, lighten the difficulty of this friction". As will be seen from what follows, this seems indeed to be exactly true.

No further progress appears to have been made in understanding the fundamentals of lubrication until the 1880's, when Osborne Reynolds in England published a paper¹ explaining the load-bearing capacity of a fluid film on the basis of hydrodynamic theory. At about the same time, Petroff² in Russia was able to calculate the friction in a fluid-lubricated bearing. Reynolds enunciated the principle that the load-bearing capacity of a fluid film was due to the pressures developed when the lubricant was drawn through a constriction, or a convergent wedge-shaped space, under the action of viscous forces and that wherever the geometry of the bearing permitted the formation of such a wedge, hydrodynamic forces would appear.

Most of the later work in this field of "hydrodynamic lubrication", i.e., where a film of lubricant occurs between the two rubbing surfaces, stems from this fundamental paper of Reynolds. The journal bearing is a typical, and perhaps the most widely used, example in which

Reynolds' theory is applicable. Numerous improvements in the theory have been made with regard to side leakage, film rupture (cavitation), effects of lubricant inertia, thermal expansion of lubricant, etc. There are, of course, some problems still to be cleared up, e.g., the observation that the parallel-sided thrust bearing can carry a moderate load hydrodynamically, of which no convincing theory has been found, even of a qualitative kind,³ but by and large the main theoretical aspects of hydrodynamic lubrication are well understood. The survey of Christopher-son in I and of Burwell in II give a fairly comprehensive account of this field.

Hydrodynamic or thick film lubrication occurs for the general run of sliding contacts, and in this the most important property of the lubricant is its viscosity, allowing fluid films to be built up and the solid surfaces to be floated apart. The friction is due to shear of the fluid layer and the coefficients of friction are generally low (0.01 or less). The designer's aim should therefore be to ensure that such a fluid film is obtained, because the friction is then low and ideally there is no wear. In practice, this is not always possible. Even in those cases where fluid films are easily formed, like journal bearings, solid to solid contact occurs on starting. In other cases, the form of the surface makes it difficult to establish a fluid film, e.g., the opposite curvature of gear teeth surfaces. Further, in the fluid-lubricated mechanism, it is naturally the aim to increase the load as much as possible; the fluid film then becomes thin and the possibility of solid surface contact is increased. A study of lubrication under other than hydrodynamic conditions is therefore highly necessary.

When a solid surface rubs another and there is no fluid-film to take the load, the regime is called "boundary lubrication". Under these conditions, it is the chemical nature of the lubricant and the surfaces which are significant. In between this and hydrodynamic lubrication, there is a field known as "thin film lubrication", where the load is partially borne by the fluid. This field is comparatively little understood; Blok has given an excellent review of its fundamental mechanical aspects in II.

Many remarkable results have been obtained in recent years with regard to friction in solid to solid contacts. Metals cleaned in the ordinary way have a coefficient of friction μ of 0.5-1, but if they are degassed in high vacuum,

* I. *Physics of Lubrication*. A Symposium held by the British Rheologists' Club and the Institute of Physics, in June-July 1950; *British Journal of Applied Physics*, Supplement No. 1, 1951, issued by the Institute of Physics, 47, Belgrave Square, London, S. W. 1, p. 90. Price 15 sh.

II. *The Fundamental Aspects of Lubrication*, Report of a Conference on the subject, held by the New York Academy of Sciences, in March 1950. *Annals of the New York Acad. Sci.*, 1951, 53, 753-994. Price \$ 4.00. These will be referred to as I and II respectively.

the value rises to 6 or more and complete seizure occurs on contact with most metals.⁴ Even a trace of oxygen or water vapour prevents seizure and the friction is appreciably reduced, obviously due to the formation of surface films. Different gases and vapours have varying effects in reducing friction. Thus, with iron, oxygen and caproic acid vapour reduce μ to about 1, while chlorine and hydrogen sulphide lead to values of the order of 0.5. Such effects are found even with diamond, μ being 0.05 for a surface cleaned in the ordinary way, while it rises to 0.4, if cleaned in vacuum. Thus, surface layers play an important part both in reducing friction and in preventing seizure. Herein lies the importance of studying the chemistry of the lubricant and its relation to the formation of surface layers. X-ray and electron diffraction methods have been used in such studies and Brill gives a review of these in II. Finch provides a short, but interesting, summary of the results regarding the structure of boundary lubricant films in I. A number of papers, both in I and II, deal with surface chemical phenomena and on the effect of various reagents on boundary lubrication. Long chain compounds, soaps, acids and esters have been tried and most of them are useful boundary lubricants. An interesting observation in this connection⁵ is that when the lubricant melts, it becomes much less efficient and also there is considerably more surface damage. This is directly related to the observation of Zisman and others⁶ that monolayers of fatty acids on platinum occur only up to temperatures slightly above the melting point. Electron diffraction study⁷ shows that good boundary lubrication occurs only when there is a closely packed solid film of oriented molecules on the surface, and above the melting point, the order is destroyed, leading to a reduction in the lubricating properties. Radioactive tracers have also been used to determine whether chemical action occurs between lubricant and the metal surface or not.⁸

For some applications, solid materials are employed as lubricants. Graphite is commonly used and its lubricating effect has been attributed to its plate-like cleavage. In I, Barwell and Milne report studies on lubrication with various powders like talc, mica, paraffin, etc. Talc, although one of the softest mineral known, has no lubricating effect at all. Micaceous minerals too are inefficient, thus throwing doubt on the view that a laminar structure necessarily endows a substance with lubricating properties. Incidentally, Savage⁹ finds that the friction of graphite in vacuum is high, but lubrication

is effected instantly by any one of a number of vapours present even at low pressures.

Wear is another aspect of the rubbing of solids equally important as friction. Ideally, there should be no wear in hydrodynamic lubrication. But it is impossible to avoid the release of particles from surfaces by occasional contacts. The particles, together with airborne dust, will lead to a certain amount of wear. Laboratory studies on this subject have not led to much practical result, because actual conditions are so varied, and a clear understanding of the wear process has not yet been obtained. Anti-wear additives, such as tricresyl phosphate and iron carbonyl, to the lubricant have been found to give good results.

It is possible to demarcate a region of boundary lubrication in which there is a high intensity of contact pressure and a high relative speed of sliding. This is variedly called as "extreme pressure" or "extreme boundary" lubrication. The former term is a misnomer for it is the sliding condition which is particularly severe; such conditions occur with hypoid gears and with metal-cutting tools. It then becomes necessary to employ a lubricant which will react with one of the surfaces to form a low shear strength solid layer which can largely prevent welding and subsequent damage and wear. In the paper by Shaw in II, the results obtained with a large number of organic compound on aluminium are given, which show that disulphides, mercaptans and long chain esters are particularly efficient. So far as practical application goes, satisfactory commercial grades of lubricants are available. There is still much interest in the fundamental aspects of the way these materials function. A possible clue is given by Finch and Spurr in I. They suggest that since the sulphide or other layer formed by the chemical reaction between the lubricant and the metal is readily fusible, it prevents the softening of the metal and the consequent rupture of the protective oxide layer. Based on the same principles, chemical pre-treatment of surfaces and thin coatings of soft metal on hard substrates have been used to promote good boundary behaviour of rubbing surfaces.

There are a few articles in both the reports dealing with other related topics, e.g., a 35-page review on "Viscosity and Molecular Structure" by A. Bondi in II and studies on viscosity at high rates of shear in I.

It has indeed been a stimulating experience to study the two reports. The discussions therein show clearly that the subject of lubrication

which until recently was mere workshop practice has now moved out of the engineer's domain to take its place as a regular branch of physical chemistry. A study of its fundamental aspects by physicists and chemists applying all the modern techniques available to them would thus appear to be essential for further progress in

the design and maintenance of almost every type of machinery.

G. N. RAMACHANDRAN.

1. Reynolds, *Phil. Trans. Roy. Soc.*, 1886, 177 A, 157.
2. Petroff, *Eng. J. St. Petersburg*, 1883, 1, 71; 2, 228; 3, 377; 4, 535. 3. Christopherson, I, p. 1. 4. Bowlen, II, p. 805. 5. Shooter, I, p. 49. 6. Bigelow, *Glass and Zisman, J. Coll. Sci.*, 1947, 2, 563. 7. Menter, I, p. 52. 8. Moore, I, p. 54. 9. Savage, II, p. 862.

ULTIMATE CONSTITUENTS OF MATTER *

PROF. CARL D. ANDERSON, of the California Institute of Technology, has presented the accompanying table of elementary particles of matter as known in March, 1951. He points out that all the particles discovered since 1932 are unstable; after a short time, they either undergo spontaneous decay or are captured by atomic nuclei.

Dr. Robert Oppenheimer as saying in this connection:

"An elementary particle is one that is so simple that one has no understanding of it whatsoever."

Besides the fourteen listed by Prof. Anderson, a fifteenth particle is also expected, viz., the anti-proton, of negative charge but with

Elementary Particles of Matter and Some of Their Interactions

Particle	Mass in electron masses	Year discovered	Average lifetime against spontaneous decay	Products of spontaneous decay
Electron	.. 1	1896	Stable	..
Proton	.. 1845	1896-1900	Stable	..
Neutron	.. 1848	1932	About 20 min.	Proton and electron
Positron	.. 1	1932	Stable	..
Positive μ Meson	.. 210	1936	2×10^{-6} sec.	Electron and two neutrinos
Negative μ Meson	.. 210	1936	2×10^{-6} sec.	Electron and two neutrinos
Positive π Meson	.. 276	1947	10^{-8} sec.	μ meson and neutrinos
Negative π Meson	.. 276	1947	10^{-8} sec.	μ meson and neutrinos
Neutral π Meson	.. 264	1950	Less than 10^{-13} sec.	Two photons
Positive V-Particle	.. Unknown	1947	Less than 10^{-9} sec.	Unknown
Negative V-Particle	.. Unknown	1947	Less than 10^{-9} sec.	Unknown
Neutral V-Particle	.. Unknown	1947	10^{-10} sec.	Probably mesons and photons
Photon	.. 0	..	Stable	None
Neutrino	.. 0	..	Stable	None

The 'elementary' character of the particles is rather uncertain; for, according to modern physical theories, particles may exist in "virtual" states in which they may have observable effects while not existing actually as independent observable particles. Dr. Anderson quotes

the same mass as the proton. According to a recent report the track of such a negative proton has already been tentatively identified in a cosmic ray disintegration photograph by Dr. Robert B. Leighton at Pasadena.

* By courtesy of the *American Scientist*.

UTILISATION OF MONAZITE

IN the course of his address to the Research Club at the Harcourt Butter Technological Institute, Kanpur, Sir S. S. Bhatnagar, Secretary, Ministry of Natural Resources and Scientific Research, observed that examination of the monazite sand from Travancore was taken up by the Government of India after World War II, and that it was found to contain cerium, thorium, and 0.14% uranium. An agreement, he said, has now been reached with the Society of Rare Earths, Paris, for setting up a factory

in India, treating 1,500 tons per year. There is already at present a pilot plant of 250 to 500 tons capacity, fetching about Rs. 15 lacs per year. In the course of a few months the factory will start functioning with full capacity. As cerium with small amounts of zirconium and magnesium has recently found use in the conversion of cast iron into steel, it is expected that when it is produced here, there is bound to be a great demand for it at very high prices.

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RUSSEL EFFECT IN INDIAN TIMBER WOODS

In a previous note in this journal,¹ the author reported results of investigations made for the first time on the activity of Indian woods on photographic emulsions (Russel Effect). The present note deals with a quantitative study of the Russel Effect in ten representative specimens of South Indian woods: (1) *Pæciloneuron indicum*, (2) *Kigelia pinnata*, (3) *Mesua ferrea*, (4) *Acrocarpus fraxinifolius*, (5) *Butea frondosa*, (6) *Erythrina indica*, (7) *Holigarna Arnottiana*, (8) *Lagerstromia lanceolata*, (9) *Tectona grandis*, (10) *Dalbergia paniculata*.

The specimens under investigation were in the form of rectangular blocks ($1\frac{3}{4} \times 1 \times \frac{1}{2}$ ") their broad surfaces being planed and smoothed. The woods were irradiated by sunlight for

10 minutes and activated thereby. They were then placed in contact with the sensitized surface of the photographic plate (Ilford Special Rapid). An exposure of 48 hours was given

TABLE I

Serial No.	Name of the wood	Transmittancy %	Density
1	<i>Pæciloneuron indicum</i>	10.3	0.985
2	<i>Kigelia pinnata</i>	20.7	0.684
3	<i>Mesua ferrea</i>	27.6	0.560
4	<i>Acrocarpus fraxinifolius</i>	30.0	0.523
5	<i>Butea frondosa</i>	31.0	0.508
6	<i>Erythrina indica</i>	31.0	0.508
7	<i>Holigarna Arnottiana</i>	31.0	0.508
8	<i>Lagerstromia lanceolata</i>	33.3	0.477
9	<i>Tectona grandis</i>	37.9	0.421
10	<i>Dalbergia paniculata</i>	58.6	0.232

in total darkness. The plates were developed for three minutes at 75° F., using ID-35 developer² and fixed in a hardening fixing bath³ (G-303).

The density of the 'Russel images' were measured with a photo-electric cell.⁴ The results are recorded in the Table.

From the table it is seen that the Russel Effect is most pronounced in the case of *Poeciloneuron indicum*. The weakest among the woods investigated is *Dalbergia paniculata*. The effect is found to be the same in the case of the three woods, *Butea frondosa*, *Erythrina indica* and *Holigarna Arnottiana*.

Further investigations on other species of woods as also on the heartwood and sapwood of woods are in progress. Details will be published elsewhere.

The author's thanks are due to the Forest Utilisation Officer, Madras, for procuring the specimens of wood.

V. P. NARAYANAN NAMBIYAR.

Dept. of Physics,
Pachaiyappa's College,
Chetput, Madras,
September 1, 1951.

1. Narayanan Nambiyar, V P., *Curr. Sci.*, 1949, **18**, 284-86.
2. *Ilford Photographic Formula*, p. 17.
3. *Geonert Photographic Formula*, p. 19.
4. Gibb, *Optical Methods of Chemical Analysis*, 1942, p. 75.

ELECTRONIC BANDS OF CERTAIN BENZENE DERIVATIVES

CONTINUING the previous work,¹ the absorption spectra of a number of disubstituted benzenes in the ultra-violet have been investigated under different pressure and temperature conditions. Results of *para*-, *ortho*-, and *meta*-substitutions by like and unlike radicals led to the determination of several fundamental vibrational frequencies. All the disubstituted benzenes investigated have allowed electronic transitions in this region. *Ortho* and *meta* derivatives gave spectra of a complicated appearance due to the large variety of vibrations that are possibly excited and resemble each other more than the *para* spectrum which is comparatively simple. The red shift of the 0,0 electronic transitions due to the substituents in these molecules is found to be in accordance with the additive rule. The progressive shift of the 0,0 band with the relative positions of the substituted radicals is found to be, in the case of the cresols, in the order *o*, *m*, *p*.

The upper state frequencies established in the

different substituted molecules are listed below:—

Molecule	Frequencies in cm. ⁻¹
<i>Para</i> -dibromobenzene ..	200, 470, 677, 1014, 1449
<i>Para</i> -dimethylbenzene ..	176, 229, 708, 771, 800, 1184
<i>Para</i> -cresol ..	415, 553, 778, 805, 1192, 2078
<i>Ortho</i> -cresol ..	208, 370, 483, 534, 701, 945, 958, 1132, 1242, 1317
<i>Meta</i> -cresol ..	183, 199, 696, 808, 950, 962, 1150, 1219, 1303
<i>Para</i> -dimethoxybenzene ..	501, 503, 802, 1297
<i>Ortho</i> -dimethoxybenzene ..	619, 918, 1021
<i>Meta</i> -dimethoxybenzene ..	590

The data compare well with the ground state frequencies obtained from Raman Effect.

A full account of the investigations will be published elsewhere.

Physics Department, K. SREERAMAMURTY,
Andhra University, Waltair,
September 6, 1951.

- 1 Sreeramamurty, *Ind. J. Phys.* 1950, **24**, 421.
2. — *Ibid.*, 1951, **25**, 123.

ON THE TEMPERATURE OF MINIMUM COMPRESSIBILITY OF IONIC SOLUTIONS

PRECISION measurements of compressibility by Randall¹ have shown that the adiabatic compressibility of water exhibits a minimum value at 64° C. The effect of dissolved ions on this temperature of minimum compressibility may be expected to throw some light on the influence of ions on water structure. Accordingly, the temperature variation of the adiabatic compressibility has been investigated for two ionic solutions—potassium chloride (1 N) and sodium carbonate (0.5 N) in the temperature range 20° C. to 70° C.

Ultrasonic velocities have been measured by using the method of secondary interferences. A stationary wave-system was formed between a quartz transducer and a parallel reflector, in a glass cell containing the electrolyte. The Hiedemann pattern obtained by focussing on a plane containing the convergence lines was photographed, and the wave-length determined by measurement of the fringe width on a comparator. The cell containing the aqueous solution was maintained successively at different temperatures with the aid of an electric heater. Compressibilities are calculated from the measured acoustic velocities, and the known densities of the solutions. It is found that the compressibility minimum occurs in the tempera-

ture range 60° C. to 65° C. for the 1N KCl solution and in the range 55° C. to 60° C. for the 0.5 N Na_2CO_3 solution. Since the temperature of minimum compressibility for pure water is 64° C., the magnitude of the decrease in the ionic solutions investigated here is not more than 10° C.

It is interesting to consider the above result from the point of view of relaxational compressibility of water. The excess ultrasonic absorption in water, it is now generally accepted, is due to a structural relaxation on the lines explained by Hall.² The compressibility of water is thus composed of (a) an "instantaneous" compressibility, due to reduction of molecular volume, and (b) a relaxational compressibility due to some molecules of state 1 being forced to state 2 of closer packing. Now, the molecular or instantaneous compressibility increases with temperature as usual, but the structural compressibility decreases due to the progressive disappearance of hydrogen bonds above 0° C. These two opposing effects combine together to give a minimum value for the compressibility, the temperature at which this minimum occurs being determined by their relative magnitudes.

The existing data concerning the properties of ionic solutions suggest that the introduction of the ions produces a more co-ordinated arrangement of the water molecules. In particular, a correlation between various colligative properties and the change in height of the minor X-ray diffraction peak^{3,4} (which is peculiarly structure sensitive), shows that the effect of ions is to carry the water structure farther to the right in the series of transformations (Bernal and Fowler⁵).

Tridymite-like—Quartz-like—Ammonia-like.

Hence the introduction of ions is expected to produce a "decrease" in the structural contribution to the compressibility and thus to lower the temperature at which the compressibility exhibits a minimum value.

I thank Professor R. S. Krishnan for guidance and valuable suggestions.
Physics Dept., V. S. VENKATASUBRAMANIAN.
Ind. Inst. of Science, Bangalore 3,
September 28, 1951.

1. Randall, *Bur. Stand. J. Res.*, 1932, 8, 79. 2. Hall, *Phys. Rev.*, 1948, 73, 775. 3. Stewart, *J. Chem. Phys.*, 1943, 11, 72. 4. Corey, *Phys. Rev.*, 1943, 64, 350. 5. Bernal and Fowler, *J. Chem. Phys.*, 1933, 1, 515.

THE SEISMIC SUSCEPTIBILITY OF THE AREA IN THE NEIGHBOURHOOD OF METTUR DAM, SALEM DISTRICT

The area in the neighbourhood of Mettur Dam has been known to be susceptible to minor

earthquake shocks at rare intervals. Such shocks were felt even before the construction of the Mettur Dam. During recent years, however, the shocks appear to have become more frequent.

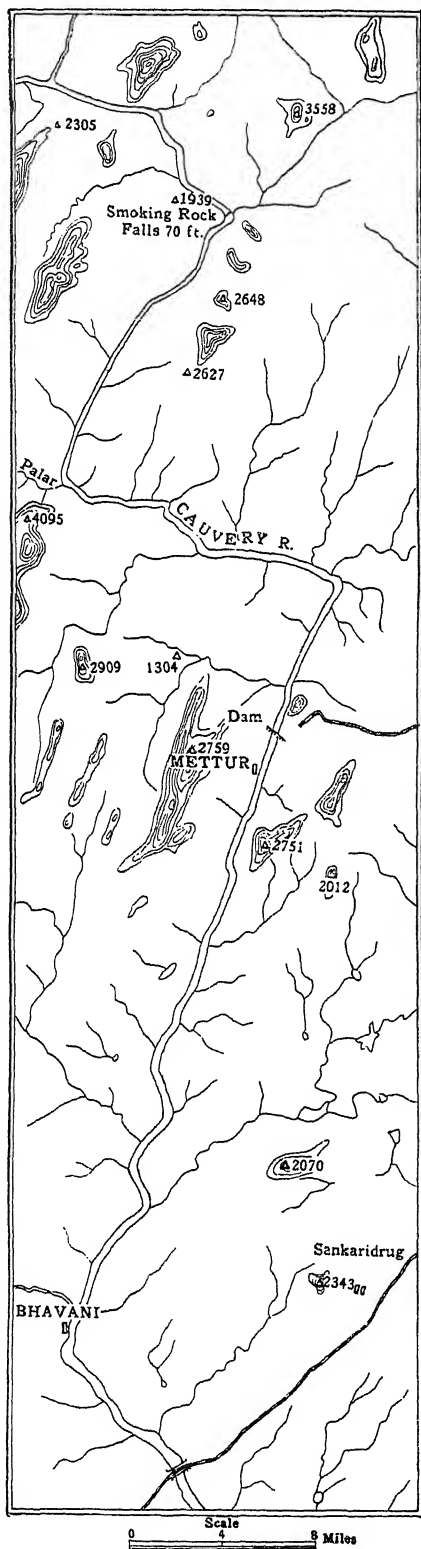
A study of the topography and the geological features of the area in the neighbourhood of Mettur Dam reveals certain peculiarities which throw some light on the causes for the occurrence of these periodic disturbances.

The sketch map given below indicates the characteristic flow of the river Cauvery above and below Mettur. Leaving the Mysore frontier the river keeps to an easterly course for about twenty miles. Near the Hogenkal or the Smoking Rock Falls the ground drops suddenly and the river plunges over a precipice 70 feet high. After this leap there is an abrupt change in the course to the SSW and from this point onwards the river flows in a narrow gorge for a distance of nearly 14 miles without deflection, suggestive of the flow being guided by a long line of fault. Meeting the river Palaru coming from the west it captures its course and flows eastwards for about ten miles. At this point, a few miles above Mettur, there is again an abrupt change in the course, the river taking an acute bend to the SSW and flowing in a straight line for a distance of nearly 35 miles as far as Bhavani.

In a recent communication to *Current Science* Ghose and myself¹ have pointed out how the straight course of the river Arkavati and its tributary twenty miles west of Bangalore is indicative of flow along fault planes. The course of the river Cauvery, here illustrated, is an even better example of river flow along fault planes. It may probably be argued that flow along tension joints parallel to strike and dip can adequately explain river flow in straight courses and that there is no necessity to invoke faulting. While such an explanation may be possible to account for the straight courses of streams and streamlets flowing over short distances it cannot be said to hold good in case of a major river like Cauvery with its large volume of water and enormous destructive power. Moreover, flow in straight courses extending for several miles cannot be explained in any other way except on the assumption that the flow is guided by a long narrow zone of weakness.

The area has not been geologically surveyed in detail and confirmatory evidence of faulting is lacking. Surface examination does not appear to have shown any signs of faulting as is evidenced by the reports of geologists on the dam site at Mettur. Excavations, however, re-

SKETCH MAP OF AREA NEAR METTUR
DAM, SALEM DT.



vealed "a very deep and extensive fault from about L.S. 2300 as far as L.S. 2850 where the rock level again rose sharply".² This was called the "Deep Hole" and the excavation at this point had to be carried down to a depth of 75 feet below ground level over the entire width of the dam. Dr. West³ who examined the cores obtained from this section, has stated that the rock which came in bits was almost white in colour, but that it was not certain whether it was a siliceous variety of the gneiss or only pegmatitic material. He has also observed that during the boring numerous sections of a very soft rock were encountered, so soft that no cores were obtained, and the drill suddenly descending several inches as each patch was reached. He was not clear as to what this was due to.

Mylonitic and trap-shoten structures are observed in outcrops in the bed of the river near Mettur. There are two east-west dolerite dykes which cross the road from Mettur to Bhavani. These dykes which cut the charnockites stop near the river and are not traceable on the other bank which is composed of pink gneisses. Rao Bahadur M. Vinayaka Rao⁴ who has examined the foundation excavations at Mettur also speaks of a dyke stopping dead at the toe end of the dam and getting much broken up.

These evidences would indicate the existence of a major line of fault which has guided the course of the river Cauvery. The identification of this weak zone would satisfactorily account for the periodic tremors felt over the area. It seems desirable to instal a seismograph at Mettur Dam to locate the centres of disturbance and also to find out whether there is any periodicity in these tremors and whether they bear any relation to the quantity of water stored in the reservoir.

B. P. RADHAKRISHNA.

Mysore Geological Dept.,
Bangalore 1,
September 25, 1951.

1. Radhakrishna, B. P. and Ghouse, M., *Curr. Sci.*, 1951, 20, 203. 2. Barber, *History of the Cauvery Mettur Project*, 1940, p.75. 3. —. *Ibid.*, Geologists' Reports p. 454. 4. —, *Ibid.*, p. 456.

MECHANISM OF FLUORINE REMOVAL BY CALCIUM SALTS

Two theories have been put forth to explain the removal of fluorine from drinking water by tricalcium phosphate and bone salt. First one is the theory of anion exchange¹ and the second is of adsorption in terms of Fründlich adsorption isotherm.² In their present form, neither of these theories alone nor a combination of the two can satisfactorily explain the fluorine-removing capacity of calcium phosphate and bone salt.

Studies have been carried out, employing different calcium salts, to elucidate the point in question and the results obtained are summarised in this communication.

(1) When a solution of sodium fluoride is equilibrated with calcium phosphate, raw bone meal and purified bone meal, it is observed that at equilibrium (a) the clear filtrate in every case has the same sodium concentration as the original solution; (b) the filtrate is alkaline, contains phosphorus and small quantities of calcium; (c) the fluorine concentration of the filtrate is less than that of the original solution, indicating that fluorine is removed by these substances. When the logarithm of the quantity of fluorine removed per gram of the substance x/m is plotted against the logarithm of the concentration of fluorine remaining in the solution at equilibrium (C), a straight line relationship is obtained in each case, i.e., $\log x/m = \log K + 1/n \log C$ or $x/m = KC^{1/n}$. This indicates that the removal of fluorine by these substances is brought about by the mechanism of adsorption. As the original solution and the filtrate at equilibrium have the same sodium concentration and removal of fluorine in each case is followed by the production of phosphate and alkalinity in the filtrate, it is deduced and has also been proved that the adsorption of fluorine by these substances is an instance of ionic adsorption, involving the exchange of fluorine with hydroxide and phosphate in calcium phosphate, and with hydroxide, carbonate and phosphate in raw and purified bone meal.

(2) As a result of heating at about 500°C. for 15 to 30 minutes, raw bone meal, purified bone meal and calcium phosphate show a decrease in their adsorptive capacity for fluorine. Except for loss in weight due to loss of moisture in calcium phosphate and due to loss of moisture and organic matter in raw and purified bone meal, there is no loss of any mineral constituent of these substances on heating. From this, it has been inferred that the reduction in the adsorptive capacity of the compounds is not due to loss in phosphorus complement of the compounds but is due to the change in their essential structure. The adsorption of fluorine by the heated compounds also is ionic and involves the exchange of fluorine with hydroxide and phosphate in calcium phosphate, and only with hydroxide and carbonate in raw and purified bone meal. The exchange of fluorine with phosphate has not been observed in the heated samples of raw and purified bone meal. Thus, it can be said that the adsorption of fluorine takes place by exchange partly with hydroxide and carbonate and partly with phosphate of

these substances and the total quantity of fluorine removed is the sum of fluorine adsorbed through these two reactions. The nature of hydroxide, carbonate and phosphate that are exchanged with fluoride in the manner of Freundlich adsorption isotherm will be discussed separately in another communication.

(3) Rock phosphate, chlor-apatite and fluor-apatite, though akin to bone salt and calcium phosphate in the disposition of the principal molecular lattices, do not exhibit any fluorine-removing capacity.

(4) When fluorine as sodium fluoride is present in the liquid phase in concentrations that are usually encountered in the samples of drinking water in the areas of endemic fluorosis, i.e., 3-5 p.p.m., calcium carbonate does not show any fluorine removing capacity; but when present in much higher concentrations, calcium carbonate removes fluorine in the manner of Freundlich adsorption isotherm, except for the difference that whereas, in the case of bone salt and calcium phosphate, the quantity of fluorine adsorbed per gram of the material increases and the percentage adsorption decreases with the increasing concentration of fluorine in the liquid phase, in the case of calcium carbonate, both the quantity of fluorine adsorbed per gram of calcium carbonate and the percentage of fluorine removed increase with increasing concentration of fluorine.

(5) Calcium oxide and calcium sulphate remove fluorine from an aqueous solution of sodium fluoride by the mechanism of anion exchange wherein the solubility of the precipitated calcium fluoride is the limiting factor for the complete removal of fluorine.

Details of this work will shortly be published elsewhere.

The author wishes to thank Prof. K. V. Giri for his keen interest in the work.

Dept. of Biochemistry,
Ind. Inst. of Science, T. K. WADHWANI.
Bangalore, July 4, 1951.

1. Gassmann, T., *Zeit. Physiol. Chem.*, 1928 **178**, 62.
2. Adler, H., Klein, G., and Lindsay, F. K., *Ind. Eng. Chem.*, 1938, **30**, 163.

NUTRITIVE VALUE OF THE SEEDS OF *AMARANTHUS PANICULATUS* LINN.

WHILE studying the nutritive value of certain little-known foodstuffs, the seed of *Amaranthus paniculatus* was taken up for investigation, as it came to our notice that the puffed seed is consumed in small amounts in various parts of the country.

Samples of the seed collected from different States showed an average percentage composition: Moisture 9-11, crude protein 14.5-16.0, carbohydrates 66.8 (starch by 'acid hydrolysis' 57.8 and 80% alcohol solubles 6.9), crude fibre 2.0 and ash 3.6. Of the ash constituents, calcium formed 6%, and phosphorus 18%. As it came to our notice subsequently, this composition is about the same as given by Sahasrabudhe,¹ who has classified the seed as an inferior millet. There does not appear to be any other published literature on the subject. The high protein and calcium content of the seed was suggestive of its value as an article of food and results presented in this note relate to this aspect.

The nutritive value of the protein of the raw seed at 10% level, as determined by the balance sheet method,² showed an average value of 80.4 ± 0.62 for digestibility coefficient, and 73.7 ± 1.25 for biological value. As determined by the rat-growth method,³ the protein efficiency ratio of the raw seed (at 10% level) was comparable with that of casein. The puffed seed, however, gave a lower value, thereby suggesting an impairment in the quality of the protein on puffing. The average figures for the increase in body weight per gram of protein intake are: casein 2.27 ± 0.09 , raw seed 2.12 ± 0.07 and puffed seed 1.90 ± 0.06 .

In experiments conducted over a period of 8 weeks, rats fed *ad libitum* with raw and puffed seeds in place of rice in the rice diet⁴ recorded an average weekly gain in weight of 13.3 gm. and 10.0 gm. respectively, as against 3.3 gm. in the case of rice.

The experimental diets had the following percentage composition: Seed (raw or puffed) or polished rice 78.5, tur dal (*Cajanus indicus*) 5.0, common salt 0.3, non-leafy vegetables 8.2, leafy vegetables 2.1, skim milk powder 0.9, and crude groundnut oil 5.0. Thus, it would be seen that the rice diet contributed, on an average, 8.0% protein and 0.05% calcium on a moisture-free basis, while the corresponding values in the diets containing raw or puffed seeds were 15.0% and 0.20% respectively. It would appear, therefore, that the higher protein and calcium content of the seed as compared to polished rice is responsible for the enhanced growth rate of animals.

Capacity for reproduction and lactation of the animals fed on the seeds was also normal in contrast to those on the rice diet.

Studies on the supplementary value of the seeds at different levels to the rice and wheat diets, its effect on the second generation of rats, the vitamin content of the raw and puffed

seeds, and the amino acid make-up of the protein are in progress.

Our thanks are due to Dr. V. Subrahmanyam, Director of the Institute, for suggesting the problem and for his keen interest in the investigation.

Central Food Tech. Res.

Institute,

Mysore,

October 1, 1951.

N. SUBRAMANIAN.

M. SRINIVASAN.

1. Sahasrabudhe, *Bulletin Dept. of Agriculture, Bombay*, No. 124 of 1925. 2. Chick, *et al.* *Biochem. J.*, 1935, 29, 1702. 3. Osborne, *et al.*, *J. Biol. Chem.*, 1919, 37, 223. 4. Subrahmanyam, V. and Sar, B. K., *Ind. J. Med. Res.*, 1949, 37, 319.

CIRCULAR PAPER CHROMATOGRAPHY FOR THE SEPARATION OF AMINO ACIDS

RUTTER¹ has described a technique using circular filter-paper discs, which possesses many advantages over other techniques and has indicated its application to the separation of dyes, inorganic substances and to the analysis of some biological materials like plant extracts. The following work was undertaken to determine how far this technique would permit a separation of amino acids in a mixture. The apparatus and technique adopted were generally those described by Rutter, with slight modifications, suggested by Rao and Beri.² A more elegant procedure would be to make a short longitudinal cut (about $\frac{1}{2}$ cm. length) at the centre of the filter-paper and to insert a folded paper strip (0.5 cm. \times 6 cm., folded at the centre). This method of providing a detachable 'tail' for irrigating the paper with the solvent, is found to be more convenient and uniform distribution of the amino acids along the respective zones is obtained.

Whatman No. 1 (15 cm. diameter) filter-paper was used. The chromatogram was developed using *n*-butyl alcohol-glacial acetic acid-water mixture (40:10:50) as the developing solvent, the time of development being about 1-1½ hours. The chromatogram after drying in air was dipped in a solution of ninhydrin in acetone³ (0.25 gr. in 100 c.c. of 95% acetone) and then dried at 37° C. in an incubator for about 15-20 minutes.

Concentric circular zones develop on the paper indicating the presence of amino acids, the diameter of each varying with the type of amino acid used. The zones are clearly visible and well defined. Fig. 1 shows four distinct circular zones of the amino acids, glycine, alanine, leucine and valine separated from a mixture. The accompanying table shows the R,

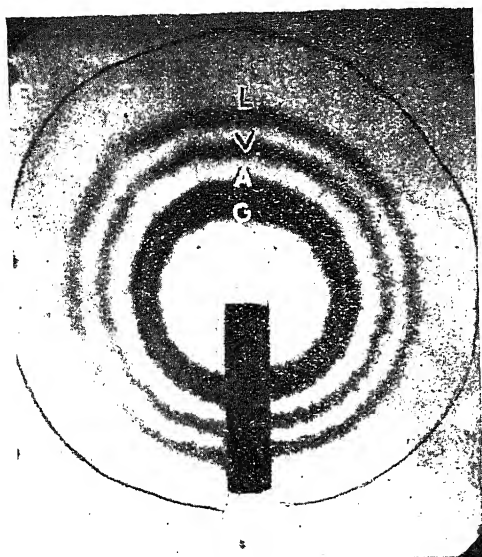


FIG. 1.

Circular paper chromatogram of a mixture of Alanine, Glycine, Leucine and Valine.

A-alanine; G-glycine; L-leucine; V-valine.

R_f Values

Alanine	..	0.44
Arginine (1)	..	0.32
Asparagane	..	0.31
Aspartic acid	..	0.37
Glutamic acid	..	0.41
Glycine	..	0.37
Histidine	..	0.50
Leucine	..	0.73
<i>iso</i> -leucine	..	0.70
<i>Nor</i> -leucine	..	0.75
Lysine	..	0.15
Methionine	..	0.92
Ornithine (2)	..	0.25
Phenylalanine	..	0.70-0.75
Proline	..	0.49
Serine	..	0.40
Threonine	..	0.44
Tryptophane	..	0.70
Tyrosine	..	0.58
Valine	..	0.62

(1) Applied as monohydrochloride

(2) Applied as hydrobromide

values obtained for the several amino acids using butanol-acetic acid-water as solvent.

In general the values are found to vary slightly from those reported by other workers by descending and ascending paper chromatographic techniques.

Amino acids which are not separated into distinct zones can be resolved by multiple development technique.⁴ Distinct improvement in the separation of the amino acids is seen after each development. Fig. 2 illustrates the application

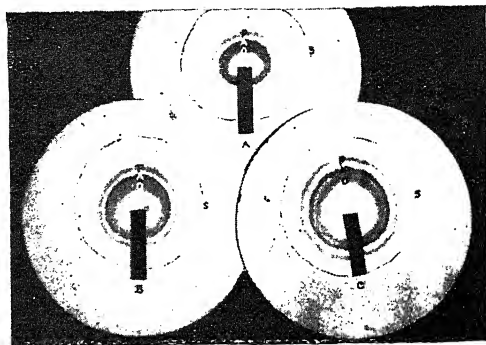


FIG. 2

Multiple development of the chromatogram of a mixture of Proline, Arginine and Ornithine.

A. First development

B. Second development

C. Third development

P. Proline

A. Arginine

O. Ornithine

S. Solvent boundary

of this technique to the separation of arginine and ornithine, which are not separated into two distinct zones by first development. By repeating the development, however, the two circular zones relating to the amino acids are separated from each other, after the third development.

Thus, amino acids can be separated by means of this technique and it is of particular interest that several chromatograms can be carried out at the same time and in short period. It is capable of wide application to the amino acid analysis of biological fluids.

Full details of the method will be published elsewhere.

Dept. of Biochemistry,
Ind. Institute of Science,
Bangalore,
October 4, 1951.

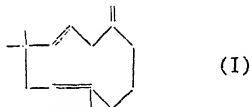
K. V. GIRI.

1. Rutter, L., *Nature*, 1948, **161**, 435; *Analyst*, 1950, **75**, 37. 2. Rao, P. S. and Beri, R. M., *Proc. Ind. Acad. Sci.*, 1951, **33**, 368. 3. Tonnie, G. and Kolb, J. J., *Anal. Chem.*, 1951, **23**, 823. 4. Jeanes, A., Wise, C. S., and Dimler, R. J., *Ibid.*, 1951, **23**, 415.

STRUCTURE OF HUMULENE

HUMULENE on treatment with Aschan's reagent yields a crystalline, tricyclic, fully saturated alcohol, m.p. 116° which appears to be identical with the α -caryophyllene alcohol of Asahina and Tsukamoto.¹ This reaction is of importance, since it transforms a monocyclic hydrocarbon into a tricyclic derivative. If the molecule of

humulene be represented by a system with more than 10 carbon atoms in a cycle, it is not difficult to visualise such a transformation which otherwise, normally is uncommon. Taking into account its close occurrence with β -caryophyllene, and the structure of the latter hydrocarbon as proposed by Sorm, Dolejs and Pliva² and modified by Dawson, Ramage and Wilson,³ the formula (I) for humulene appears to be attractive.



This explains the reactions of the hydrocarbon known so far. The formation of lävulinic aldehyde⁴ can be explained if the exo-cyclic double bond becomes endocyclic. If such a system can be transformed into a bicyclo-compound, we should normally expect a potential naphthalene or a potential azulene derivative. Humulene on treatment with *p*-toluene sulphonic acid gives a bicyclo-humulene which, on dehydrogenation over Pd-C at 325-335°, gives an azulene.

Though the present studies are far from complete, it has been thought desirable to place the results of the investigation on record in view of the publication of an advanced communication by Clemo and Harris⁵ on this subject.

Controlled oxidation of a dihydrohumulene and further work is in progress to throw more light on the subject.

The humulene for this investigation was isolated from the essential oil of Wild Ginger⁶ (*Zingiber zerumbet* Smith) and had b.p. 104°/3 mm., n_D^{25} 1.5005; d_4^{25} 0.8900; and $[\alpha]_D^{25}$ -0.9°.

Full details will be published elsewhere.

The author is thankful to the National Institute of Sciences of India for the award of the Senior Fellowship.

Organic Chemistry Laboratories, SUKH DEV.
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Bangalore 3.

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ANTITUBERCULAR ACTIVITY OF *CUCURBITA PEPO*

THE following communication deals with the anti-tubercular activity of *Cucurbita pepo*, a vegetable widely recommended, for arresting hæmoptysis and controlling the disease process in pulmonary tuberculosis.^{1,2}

C. pepo. Roxb. 700. *N. O. Cucurbitaceæ* (Syn. white melon, *Budi-gumbala*, *Kushmanda*) is cultivated in gardens throughout India. The fruit is used as a household vegetable. Extract from the ripe fruit is regarded as a diuretic, tonic and is used in painful micturition, calcareous affections and general urinary disorders, besides its specific use in tuberculosis.

The outer skin and the inner seeds having been removed, the fleshy part of a ripe, well-preserved fruit was minced with an equal quantity of water in a waring blender; the extract was concentrated to half its volume over a water-bath and strained through muslin. Further concentration was carried out under reduced pressure and finally dried over CaCl_2 in a desiccator. The yield was 10% of the original weight. A brown sweet-smelling syrupy liquid of the consistency of treacle, of pH 6.8, was the product obtained.

"In vitro" tuberculostatic activity.—This was first determined in Youman's synthetic liquid media using D_{13} and $H_{37}R_v$ strains of *Myco. tuberculosis*, by methods already described.³ The extract inhibits the growth of these virulent strains completely in a 1/10,000 dilution and retards more than 50% of the growth in a 1/100,000 dilution.

The tuberculostatic action was next tested by incorporating the various dilutions of the extracts in a rich nutrient solid media (Petrick's⁴ media gave the best results in our studies), and seeding varying amounts of different strains of *Myco. tuberculosis*. Tests were made in duplicate, the results being noted at the end of 3 weeks. Table I summarises the results obtained against an inocula of 0.1 mg. of tubercle bacilli.

TABLE I
Anti-Tubercular Activity of a Watery Extract of
C. pepo in Petrick's media

Concentration of the extract	Strain of <i>Myco. tuberculosis</i>		
	D_{13}	$H_{37}R_v$	B.C.G.
1/100	—	—	—
1/1,000	—	—	+
1/10,000	+	2+	2+

— No growth; + to 2+ various grades of growth.

The growth of the fresh virulent strain D_{13} was partially inhibited at 1/10,000 dilution. Complete inhibition of both the virulent strains was obtained in 1/1,000 dilution while the action against the non-virulent B.C.G. was of a much lower order.

The general anti-bacterial activity of the extract against some non-acid-fast organisms was

determined by the standard turbidometric method, with the results shown in Table II.

TABLE II
Bacteriostatic Activity of *C. pepo*

Organisms	Extract concentration		
	1/100	1/1000	0
<i>Staphylococcus aureus</i>	—	+	+
<i>Streptococcus pyogenes</i>	—	+	+
<i>Bact. coli</i>	±	+	+
<i>Bact. typhosum</i>	±	+	+

± slight growth.

While the extract retarded the growth of a virulent strain of *Myco. tuberculosis* in 1/10,000, the bacteriostatic action against the gram + and gram -ve bacteria tested above was very slight, indicating thereby that the extract exerted a specific action against the virulent acid-fast *Myco. tuberculosis*.

The extract, though crude in nature, is thus seen to possess tuberculostatic activity of a degree, which could possibly be therapeutically useful.

Details are being reported elsewhere. The identification of the active principles and the *in vivo* evaluation in experimental murine tuberculosis is under investigation.

Our thanks are due to Dr. K. P. Menon for his advice and guidance.

Pharmacology Labs., M. SIRSI.
Biochemistry Dept., P. R. J. GANGADHARAM.
Ind. Inst. of Science, N. N. DE.
Bangalore,
October 9, 1951.

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SPECIFIC AGGLUTINATING ACTIVITY FOR HUMAN RED BLOOD CORPUSCLES IN EXTRACTS OF *DOLICHOS* *BIFLORUS*

THE presence of hæmagglutinating substances in the seeds of certain plants has been known for a long time.³ Renkonen,⁴ Boyd and Reguera¹ and Boyd² have studied the agglutinating activity of many species of plants against human red blood corpuscles. Boyd and Reguera found that saline extracts of the seeds of certain beans, especially Lima beans, possessed A specificity, the most powerful being a variety of *Phaseolus limensis* var. *limenianus* which was active against A₁ and A₂ cells in titres of 243 and 27 respectively. These authors tested one variety of *Dolichos* (*Dolichos lablab*) and found

it to be active against human red corpuscles of groups A, B and O.

It is the purpose of this communication to record specific activity against human red blood corpuscles of group A (and AB) in saline extracts of the seeds of *Dolichos biflorus*. There was no activity against cells of groups B and O. The extracts were prepared by the mortar and pestle technique of Boyd and Reguera. Fresh extracts of one variety of these seeds (*Dolichos biflorus*—Belgaum 1-1-8) were found to agglutinate A₁ and A₂ cells in titres of 32, 768 and 16 respectively. The avidity was adequate for a blood typing reagent, powerful agglutination resulting with the undiluted extracts in 1 minute against A₁ cells, and in 4½ minutes against A₂ cells.

This extract agglutinated all of 86 samples of A₁ cells, 6 samples of A₂ cells, 25 samples of A₁B cells and 2 samples of A₂B cells. Activity against A₂B cells was weak. No false positives or negatives were encountered. The extract was compared with a standard human anti-A serum of average potency. The macroscopic titres against the various sub-groups tested are shown below:—

Cells	Extract of <i>Dolichos biflorus</i> —Belgaum 1-1-8	Human anti-A serum
A ₁	32768	1024
A ₂	16	32
A ₁ B	512	128
A ₂ B	1	16

The activity was not lost if the extract was stored in the frozen state, or if freeze-dried and reconstituted. Storage at room temperature was unsatisfactory since, after about a month, the extract produced some hæmolysis of cells of groups of A, B and O. A similar phenomenon resulted after about two months in the case of the extract stored at 4° C.—6° C. This is not a serious objection to the use of these extracts, because they are so easy to prepare. If it is not possible to store the extracts in the frozen or dried state, they can be made up from the seeds whenever required. A 2% suspension of fresh cells should preferably be used for carrying out tests with these extracts. When older cell suspensions were used, the agglutination which resulted was weaker than with fresh suspensions.

Saline extracts of *Dolichos biflorus* (Belgaum 1-1-8) may therefore be used as a cheap and easily prepared anti-A blood grouping reagent. Sera of human and animal origin are much more expensive, require more complicated preparation, and seldom, in the case of human sera, have

such a high anti-A₁ titre. So far, no satisfactory plant anti-B reagent has been discovered, though the search for this continues.

The full results of an investigation into the hæmagglutinating properties of extracts of Indian plants will be published later.

I am grateful to Dr. B. N. Uppal and Dr. L. S. S. Kumar, for provision of seeds and much valuable aid, to Mr. K. K. G. Pillai for technical assistance and to the Director-General, Armed Forces Medical Services, India, for permission to publish this note.

Blood Transfusion Dept., G. W. G. BIRD.

Armed Forces Medical College,

Poona 1,

September 15, 1951.

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THE IDENTITY OF *SCIRPOPHAGA* SPECIES ASSOCIATED WITH SUGARCANE IN INDIA (LEPIDOPTERA: PYRALIDAE)

RECENTLY, Kapur¹ (1950), has fully revised the taxonomy of the group of Crambine moths associated with sugarcane in India, by actual comparison with type material in the British Museum (Natural History). In this note the systematic position of the so-called different species of schenobiine moths attacking sugarcane in India, is discussed.

Hampson² (1896), recorded six species of *Scirpophaga* (Treitschke) from India. He distinguished the different species chiefly by the colour of the wings and of the anal tuft of hairs of the females. Fletcher and Ghosh³ (1919), mentioned two species of *Scirpophaga* from Pusa (Bihar), viz., *S. xanthogastiella* Walk. (= *auriflua* Zell.) and *S. monostigma* Zell. Later, Fletcher⁴ (1928), distinguished two species, i.e., *S. nivella* (= *xanthogastiella* Walk.) and *S. monostigma*, the latter differing from the former in the forewing having a black spot. Cherian and Subramaniam⁵ (1938), state that both the spotted (*monostigma*) and the non-spotted (*nivella*) specimens from Coimbatore (South India) have been identified by Dr. Tams of the then Imperial Institute of Entomology, London, as *S. rhodoproctalis*, Hampson.

Mr. M. C. Cherian informed us (*in litt.*) that the Director of Imperial Institute of Entomology, while forwarding the identification wrote to him thus: "The species of *S. auriflua* and

S. rhodoproctalis are distinct. The male genitalia will at once distinguish the specimens of that sex and the females may be recognised by the colour of the anal tuft which is yellow in *auriflua* and red or pinkish in *rhodoproctalis*. The identity of *S. monostigma* is still uncertain as Mr. Tams has not been able to trace the type and the description is not sufficient to enable the species to be determined with certainty. It is quite likely that it may prove to be a synonym of one of the two species mentioned above."

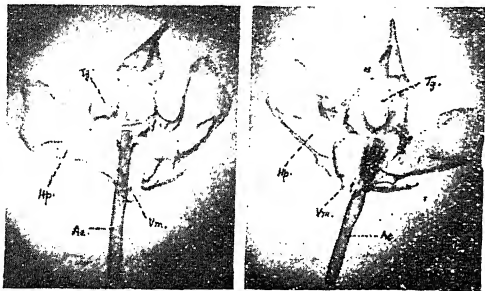
According to the letter quoted above, *S. auriflua* (*nivella*) is distinct from *S. rhodoproctalis* and the distinction in the female is based on the colour of the anal tuft and in the male by the structure of the genitalia. We have not been able to compare the structure of the genitalia of *rhodoproctalis* from Singapore with our specimens. It is, however, not known whether the terminalia of the two species have been comparatively studied by Tams. As regards the colour of the anal tuft in the female, this character does not seem to be constant and is found to vary even in the progeny of the individuals bred from a particular locality. The colour of the anal tuft in the females of *S. nivella* and *S. monostigma*, has been found to vary from yellowish brown to pinkish or even reddish.

We have before us in the National Pusa Collection a large number of specimens of *Scirpophaga* bred from different localities in India. A careful study of the immature and adult specimens from various localities shows that they all apparently belong to one species only. The habits and life-history are not only similar but the larval and pupal stages of the so-called different species bear identical morphological characters [Isaac and Rao,⁶ (1941); Isaac and Venkatraman,⁷ (1941)]. The original description of *Topeutis* (= *Scirpophaga*) *rhodoproctalis* has been based on a female collected from Singapore and described by Hampson⁸ (1919), as follows: 'Head, thorax and abdomen silvery white, the anal tuft rose-pink; antennæ blackish at sides; fore tibia on outer side, the fore and mid tarsi and the hind tarsi except basal joint fuscous. Wings silvery white, the forewings with small black spot at lower angle of cell. Hab. Singapore (Ridley) I type, exp. 36 mm.' The above description agrees generally with that of *S. monostigma* in the presence of the black spot at lower angle of cell.

Breeding experiments carried out by one of us (Venkatraman), at the Sugarcane Breeding Station, Coimbatore, proved beyond doubt that *S. nivella* and *S. monostigma* are one and the same species. The two species inter-breed freely. When a male of *monostigma* (spotted)

mated with a female of *nivella* (non-spotted) the resulting offspring were found to contain both the spotted and the non-spotted forms. Even amongst the spotted ones obtained as a result of the crossing there were gradations of sizes of spots on the wings.

Photomicrographs 1 and 2 show the male genitalia of *S. nivella* from Delhi and *S. monostigma* from Coimbatore, respectively. It may



Photomicrograph 1. Male genitalia of *Scirpophaga nivella* from Delhi. Ae. Aeagus; Hp Harpes; Tg. Tegumen Vm. Vinculum.

Photomicrograph 2. Male genitalia of *Scirpophaga monostigma* from Coimbatore. Lettering as above.

be seen that there appears to be no typical difference in the structure of the genital armature in the spotted and non-spotted forms. In the light of the above observations, it may be concluded that the species of *Scirpophaga* occurring in India are identical and that there is only one species, viz., *Scirpophaga nivella* Fabricius, which being the earliest name has precedence over others.

Division of Entomology, E. S. NARAYANAN.
I.A.R.I., New Delhi, T. V. VENKATRAMAN.
June 29, 1951.

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A PTEROMALID HYPERPARASITE ON *STENOBRACON DEESAE* (CAM.)

Stenobracon deesae (Cam.) is a potential larval parasite of the sugarcane and maize borers. Recently, a pteromalid hyperparasite (Fig. 1)

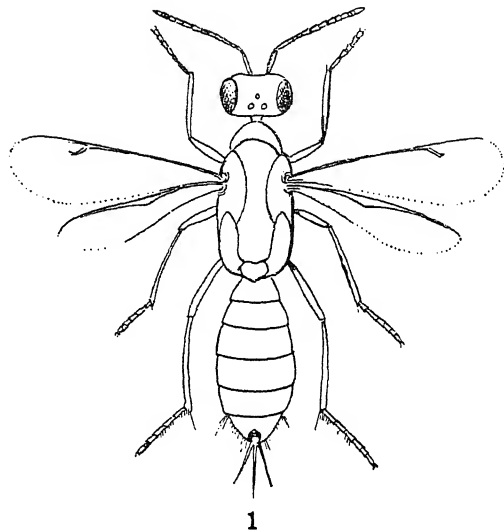
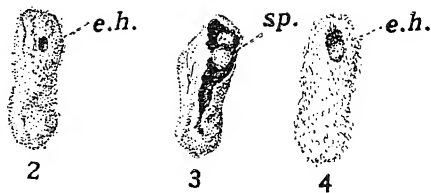


FIG. 1. Pteromalid female $\times 16$.
,, 2. *Stenobracon* cocoon showing exit hole of hyperparasite.
,, 3. " " cut open, to show pupal remains.
,, 4. " " healthy showing exit hole of parasite.

Lettering. e. h. exit hole; s.p. *Stenobracon* pupal remains. has been found to parasitise the pupæ of *S. deesae* in Delhi. So far, there is no record of any hyperparasite attacking *Stenobracon*.

The pteromalid selects fairly advanced pupæ of *Stenobracon* for oviposition. Generally, only one hyperparasite is found to emerge from a single pupa. The female wasp starts laying eggs soon after emergence, if a host of suitable stage is provided. The female pierces the tough parasite cocoon by means of its long ovipositor and lays eggs inside the abdomen of the pupa. Fig. 2 shows the cocoon of *Stenobracon* containing the exit hole (e.h.) of the hyperparasite and Fig. 3 shows the same cut open to show the remains of the *Stenobracon* pupa on which the hyperparasite grub had fed (s.p.). Fig. 4 shows the healthy cocoon from which the *Stenobracon* parasite has emerged out. Healthy cocoons are whitish in colour, while those attacked by the hyperparasite are dark brownish in colour.

The authors feel that the discovery of a hyper-

parasite on *Stenobracon* will be a warning to other entomological workers in India, to examine their material more carefully before introduction and establishment of the parasite in the field.

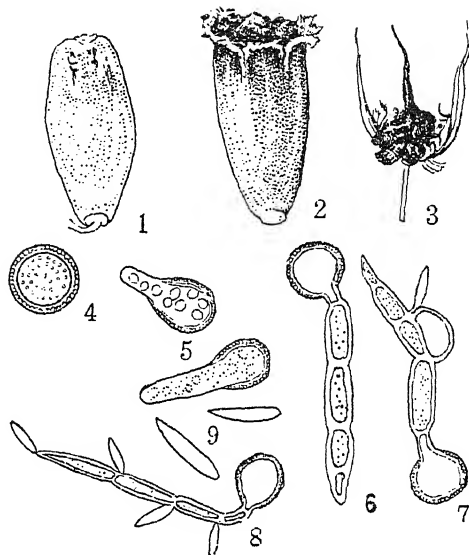
Div. of Entomology, E. S. NARAYANAN.
I.A.R.I., New Delhi, T. V. VENKATRAMAN.
July 19, 1951. B. R. SUBBA RAO.

A NEW SMUT OF SUGARCANE

On sugarcane, only culmicolous type of smut caused by *Ustilago scitaminea* Syd. and its two varieties (Mundkur, 1939), are known to occur. A few unusual infections of sugarcane smut reported by Chona (1943), affecting leaves, stem and inflorescence were also ascribed to *U. scitaminea*. But in June, 1950 the senior author, during his tour to Karnal, observed an ovaricolous smut on two sugarcane varieties, Co. 560 and Co. 561, in a collection of about 600 varieties growing at the sugarcane sub-station. Some of the affected plants were brought to Delhi and transplanted for further observations.

The smutted plants are stunted in growth, the internodes are shortened and there is profuse tillering as also the production of laterals by the sprouting of the normally dormant buds of the affected shoots giving them a bushy appearance. The affected plants come into flower much earlier in the season (May-June), and smutted panicles continue to appear for a long time. Almost all the panicles produced are smutted, rarely one or two may escape infection, and all the flowers are smutted suggesting the systemic nature of the smut.

The sori are developed in essential organs of the host. Both stamens and pistil are transformed but at times only the ovary may be transformed. The sorus when still enclosed in the glumes, is elliptic or barrel-shaped (Fig. 1) but tends to become conical later. The sorus is hypertrophied about 1½-2 times the size of normal ovary and is enclosed in a whitish grey papery membrane, which is formed of fungal tissue. The sorus is usually 7-8 mm. long and 2-3 mm. broad but the size seems to be largely determined by environment. Sori greatly different in size have been observed at different times of the year. The soral membrane may burst before the sorus comes out of the glumes or soon after, thus exposing the blackish powdery spore mass for dissemination. The rupture usually takes place at the tip (Fig. 2) but eventually the entire membrane disintegrates. In the centre of each ruptured sorus, a rod-like structure, *Columella* (Fig. 3), shows itself up prominently and persists for a considerable time. The *columella* is hard, pointed at the tip



and thicker towards the base, straight or slightly curved, about 6-7 mm. in length though *columella* 12 mm. long have been occasionally met with. It is composed of the host tissue in the centre with a peripheral layer of fungal tissue.

Spores completely fill the space between the *columella* and the soral membrane and those nearer the *columella* are lighter in colour and smaller in size. They are roundish, Saccardo's Umber to light brownish olive in colour (Ridgway, 1912), and provided with epispore of uniform thickness having indistinct pittings (Fig. 4). Sometimes intermixed with the spores are hyaline roundish cells of the same size as the spores or somewhat smaller. The pseudoparenchymatous soral membrane consists of hyaline, roundish cells with very thick walls.

Germination of spores (Figs. 5 and 6), occurs readily in water and the spores start putting forth germ tubes in about 4 hours' time, the optimum temperature for germination being 25-26° C., the maximum 30-31° C. and the minimum 10-12° C. Normally the spore produces a 4-celled promycelium on which fusiform sporidia, both terminal and lateral (Fig. 8), are produced. Sometimes two cells of the promycelium may join together by buckle joint (Fig. 7). Ordinarily numerous sporidia are produced which bud out secondary sporidia. If, however, the temperature for germination is unfavourable, say 30° C., or above, spores germinate directly into a germ tube. The sporidia (Fig. 9) are hyaline, single-celled, fusiform and measure 10-15 μ (mostly 12-13 μ) in length.

In India, three closely allied species of *Sphaerellotheca* resembling the one under study have

	Range	Highest Fr- quency	Average
<i>Sphacelotheca schweinfurthiana</i> on <i>Saccharum munja</i>	7-10 × 6-10 μ	8-9 × 8-9 μ	8.3 × 7.8 μ
<i>Sphacelotheca schweinfurthiana</i> on <i>Imperata cylindrica</i>	7-11 × 6-11 μ	8-9 × 8-9 μ	8.6 × 8.2 μ
<i>Sphacelotheca sorghi</i> on <i>Sorghum vulgare</i>	5-9 × 5-9 μ	5-7 × 5-7 μ	6.9 × 6.2 μ
<i>Sphacelotheca cruenta</i> on <i>Sorghum halepense</i>	5-9 × 5-8 μ	7-6 × 7 8 μ	7.8 × 7.5 μ
<i>Sphacelotheca</i> sp. on <i>Saccharum officinarum</i> (Co. 560 and Co. 561)	5-9 × 5-8 μ	7-9 × 7-8 μ	7.9 × 7.6 μ

been recorded on Graminae. These are *Sphacelotheca schweinfurthiana* (Thum.) Sacc., *S. sorghi* (Link) Clint. and *S. cruenta* (Kuehn) Potter. Apparently all look alike. However, there are some minor differences between them. Their spore measurements (based on the study of 50 spores each), are as follows:

But for the spores of *Sphacelotheca sorghi* which are comparatively smaller, in the others there is hardly any difference of diagnostic value. In *Sphacelotheca schweinfurthiana* the sori tend to be tubular, slightly curved and pointed but they are ovate in *Sphacelotheca sorghi*. In *Sphacelotheca cruenta* and *Sphacelotheca* sp. on *Saccharum officinarum* (Co. 560 and Co. 561) they tend to be intermediate between the two in shape. Furthermore both these latter species are distinct from *Sphacelotheca schweinfurthiana* and *S. sorghi* in having indistinct pittings on the episporium. As *Sorghum halepense* happens to be one of the parents of Co. 560 and Co. 561, and this smut agrees in all respects with *Sphacelotheca cruenta* (Kuehn) Potter, the two smuts are considered identical. No *Sphacelotheca* sp. has so far been recorded on sugarcane.

Further studies on the cross-inoculation tests of these smuts are in progress.

Grateful thanks are due to Dr. R. S. Vasudeva, for helpful criticism and for providing the necessary facilities.

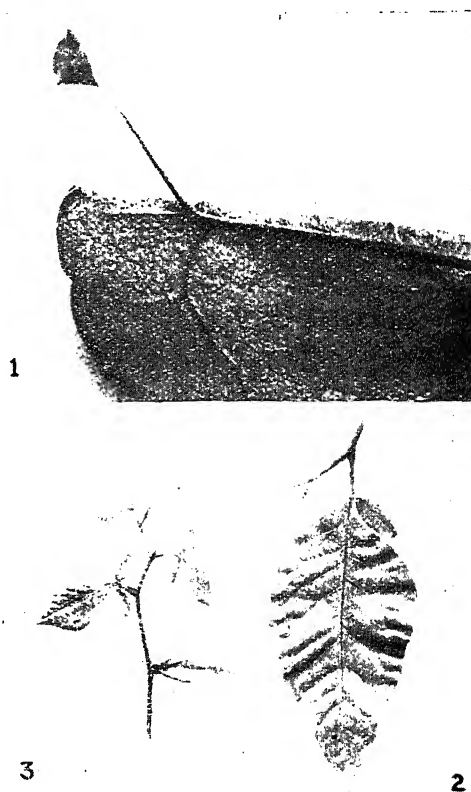
Div. of Mycology and
Plant Pathology,
Ind. Agri. Res. Institute,
New Delhi, July 6, 1951.

B. L. CHONA.
R. L. MUNJAL.

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SOME LEAF ABNORMALITIES OF AEGLE MARMELOS CORR.

THE terminal leaflet of one of the leaves collected from an *Aegle Marmelos* (Rutaceae) tree growing in the departmental garden showed the formation of an ascidium (Photo 1). The cup-shaped ascidium measured 2 mm. across and had a stalk 7 mm. long and arising from the midrib on the lower side of the terminal pinna at a distance of 5 mm. from the



Explanation of Photographs.

1. Terminal leaflet showing the stalked ascidium arising from the midrib on the lower side of the pinna. $\times 3$.
2. A single leaf on a branch showing only two leaflets the third (basal) leaflet being suppressed. $\times \frac{1}{2}$.

3. A small branch showing a few normal trifoliate leaves and one leaf where the two basal leaflets are suppressed and only the terminal leaflet remains. $\times \frac{1}{2}$.

tip. Serial sections of the ascidium, its stalk and the part of the leaf on which it is borne, showed the following anatomical features. The single arc-shaped bundle of the leaf midrib is cut into three arcs by sclerenchymatous wedges. One of these arcs moves to the lower side, into the stalk, and splits up into a number of strands. These later on arrange themselves into a concentric bundle with plates of xylem, and traverse in this manner the greater part of the stalk of the ascidium. Just near the base of the ascidium the stalk becomes hollow in the

centre and the concentric bundle flattens out into a small arc as in the midrib of the leaf. This is the only prominent bundle seen in transverse sections of the ascidium. From this bundle arise a number of strands like the lateral veins from the leaf midrib and form a regular network in the ascidium. In all these bundles the xylem faces the interior of the ascidium. The mesophyll of the ascidium is differentiated into the spongy and palisade. The ascidium is lined by a layer of epidermis below which occurs the palisade parenchyma, 2-3 cells thick. A few stomata were also found interrupting this epidermis. Secretory cavities occur both in the leaf and in the ascidium but are not seen in the stalk.

The ascidium described above falls under the category known as *Notoascidium*.¹ Worsdell² mentions that such ascidia have been seen arising from the lower side of *Brassica oleracea* (Cabbage) leaves and has figured a specimen of the same species showing the ascidium arising from the upper surface.³ Other examples quoted by him are *Hedera helix*, *Michælia champaka*, and the well-known and quite common *Codiaeum variegatum*. Masters⁴ has also figured a lettuce leaf showing an ascidium on the underside.

It appears as though the ascidium described in this note is of the nature of an enation—a stalked leaf with an abbreviated lamina (formed by the excavation of the stalk) which has folded itself inwards to form an epiascidium. The outer surface of the ascidium is evidently the morphological lower surface of a leaf. This is borne out by the fact that the xylem of the bundles and the palisade tissue both face the interior of the ascidium. This direction is quite opposite to the one in which the same tissues of the leaf face. This fact is quite in obedience to the 'law of laminar inversion, according to which opposed laminar surfaces are similarly constituted'.⁵

Other abnormalities noticed were the suppression of one (Photo 2) or both the basal leaflets (Photo 3), of the trifoliate leaf. Both these cases come under the category known as Simplification.⁶ Penzig⁷ quotes examples of *Aegle Marmelos* leaves where the terminal leaflet itself is modified into a small basal epiascidium. So far as could be made out no other leaves of the small tree in the departmental garden showed the ascidium figured in Photo 1, nor did any of the pinnæ show the basal epiascidium quoted by Penzig. The occurrence of a *Notoascidium* and the other abnormalities referred to above have, so far as I am aware, not yet been recorded in *Aegle Mar-*

melos. I wish to express my thanks to Mr. K. P. Srivastav who very kindly cut the serial sections for me.

Department of Botany,
University of Lucknow,
September 6, 1951.

A. R. RAO.

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3. —, *loc. cit.*, pl. XV, fig. 2.
4. Masters, M. T., *Vegetable Teratology*, 1869, 313.
5. Worsdell, W. C., *loc. cit.*, p. 196.
6. —, *Ibid.*, 182.
7. Penzig, O., *Pflanzen-teratologie*, 1921, 2, 201.

HALF INFERIOR OVARY IN A VARIETY OF KHARBOOZA, *CUCUMIS MELO* L.

THE character of inferior ovary is very much fixed in the family *Cucurbitaceæ*, but in a recent survey of the eastern districts of Uttar Pradesh to collect different variants of kharbooza (*Cucumis melo*, L.) it was found that, in all the variants numbering 90, the ovary is never completely inferior as it is found in other species of the genus *Cucumis* or varieties of *C. melo* L. like kakri (var. *utilissimus*), phut (var. *Momordica*). In Kharbooza, as a rule, the calyx-cup always falls short of the developing ovary, and a small part of the ovary is always left exposed at the apical end. This exposed part appears as a cap on the rim of the calyx-cup and varies in size and form in different variants.

In the type under investigation the exposed part of the ovary is practically half out of the calyx-cup (Fig. 1).

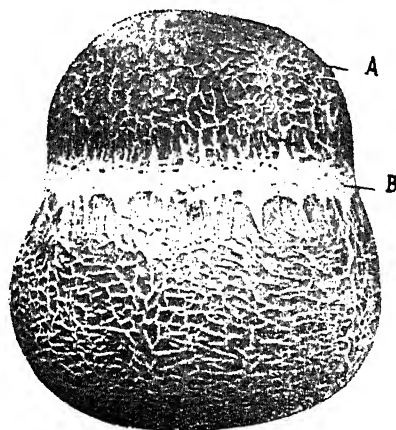


FIG. 1. A fruit of *Cucumis melo* L. (Kharbooza) showing half exposed ovary. A. Exposed ovary. B. Rim of the calyx-cup.

It is proposed to continue the work in other parts of the State.

Herbarium,
The National Botanical Gardens,
Lucknow, September 19, 1951.

K. N. KAUL.

OBSERVATIONS ON THE VIABILITY OF FREEZE-DRIED RANIKHET (NEWCASTLE) DISEASE VACCINE

FOLLOWING the technique of Iyer and Dobson (1940), who first showed that virulent Newcastle disease virus (the identity of which with the Ranikhet disease virus has been fully established) could be attenuated by serial passages in embryonating eggs, Haddow and Idnani (1946), evolved a strain of attenuated Ranikhet disease virus which has proved most effective in affording protection against this highly fatal disease of fowls and since then, a vaccine prepared from this strain is being extensively used in India and many foreign countries. The immunity produced by such a vaccine has now been shown to last up to at least four years which is practically the normal span of life of a fowl (Seetharaman, 1951).

On account of its very fragile nature, this vaccine is liable to deteriorate rapidly under ordinary atmospheric conditions. Experiments were undertaken with a view to evolve a desiccated product with better keeping qualities so that the vaccine could be supplied in a potent form by post even to places far away from the place of its manufacture.

The first attempts in this direction were to dry the vaccine, which consists of live attenuated virus contained in the allantoamniotic fluid collected from the embryonating eggs used for the propagation of the virus, in 0.25 c.c. volume in 0.5 gm. glucose base. The powder thus obtained on test in fowls did not show any signs of deterioration as compared with the original wet vaccine. It was also found to be potent when tested after 5 days' storage at 37° C., after 15 days at 32° C. and after 90 days at room temperature (19–26° C.). But when despatched by post to different places in the plains in the month of October and received back for test, the vaccine proved potent after 5 days but not after 7 days of despatch; thus indicating that although some improvement had been effected in the keeping quality of the vaccine as a result of desiccation, it was not to the desired extent.

On the assumption that virus particles lodged in the intact cells would be less liable to the action of physical agents, like heat and light, it was decided to incorporate into the vaccine for drying, the chorioallantoic membrane from the infected eggs. This membrane was found to have in it the same concentration of virus as the allantoamniotic fluid. A suspension, prepared by grinding the membrane in double its quantity of allantoamniotic fluid was dried by cryochem process in small tubes in 0.25 c.c. quantities. On test, this powder was found to

retain its potency after 40 days' storage at 37° C. and after 21 days' storage at 42° C.—the maximum period of storage so far tested. Tubes containing this dried vaccine were despatched by post to Lucknow, Bombay and Madras and were received back after periods varying from 6 to 16 days. When tested in fowls, this vaccine was found to be potent even in a dilution of 10^{-7} . The dilution of the wet vaccine used as a routine for vaccination of fowls being 1 c.c. of a 10^{-3} dilution, the dry vaccine prepared as above when used in the same dilution of 10^{-3} provided a fully potent product capable of easy despatch by post even to remote places.

Large scale field trials are being undertaken with this new product to compare its immunising properties with those of the original wet vaccine. The details of this work along with the results will be published in due course.

Ind. Vet. Res. Inst.,

M. R. DHANDA.

Mukteswar-Kumaun, U.P.

C. SEETHARAMAN.

May 22, 1951.

P. R. NILAKANTAN.

1. Haddow, J. R., and Idnani, J. A., *Indian J. Vet. Sci.*, 1946, 16, 45. 2. Iyer, S. G., and Dobson, N., *Vet. Res.*, 1940, 52, 889. 3. Seetharaman, C., *Indian Sci. Congr. Assoc.*, 1950; *Ind. J. Vet. Sci.*, 1951 (in press).

SPONTANEOUSLY-ORIGINATED HEXAPLOID AND TETRAPLOID PLANTS IN *CAJANUS CAJAN* MILL SP.

TEN unusual plants, having thicker and larger leaves and abnormal floral structures as compared to those of the diploid plants, were observed at Kanpur during 1950–51. Chromosomal counts from smear preparations of the anthers showed that one plant was hexaploid, $N = 33$, and nine plants were tetraploids, $N = 22$. The hexaploid plant was definitely smaller in height than the representative plants of the tetraploids or the diploids. The hexaploid plant did not set a single seed. Out of the tetraploid plants two set sufficient number of seeds, three set a few seeds only and the remaining four did not set any seed at all.

A probable cause of the origin of such a large number of polyploids may be the doubling of chromosome numbers in the diploids, giving rise to tetraploid plants, and in a triploid, which may have been present in the field, giving rise to hexaploid plant, by natural cold treatment of the standing crop by hail storm during the month of March in 1950.

The detailed chromosomal configurations and morphological descriptions of these plants will be published later.

Govt. Agricultural College,
Kanpur,

G. N. PATHAK.
R. S. YADAVA.

July 31, 1951.

REVIEWS

The Chemistry of Uranium, Part I. The Element, Its Binary and Related Compounds. By J. J. Katz and E. Rabinowitch. McGraw-Hill, 1951. Pp. 610.

The book under review forms the fifth volume of Division VIII of the National Nuclear Energy Series, an important publication sponsored by the United States Atomic Energy Commission. This series publication, which when completed would run into several volumes, contains a comprehensive account of the scientific and technical achievements of the war-time projects for the development of atomic energy.

Very little was known about the chemistry of uranium before 1940. As a knowledge of the chemical properties of uranium and its compounds was required in the development of nuclear energy, a detailed programme of experimental research in uranium chemistry had to be undertaken even at the very inception of the Atomic Energy Project. These investigations led to a vast accumulation of new chemical information. After the war, the publication of the results of fundamental research in the field of uranium chemistry in the National Nuclear Energy Series was entrusted to Dr. Katz and Dr. Rabinowitch who were both employed in the Information Division of the Manhattan Project. The first part of this treatise on uranium chemistry has just been published and is being reviewed here. It deals with the element uranium—its occurrence, preparation and physical and chemical properties—and simple uranium compounds. It is the field described by the vague term, "Dry Uranium Chemistry".

The book is divided into 16 chapters, which have been grouped into four parts. Part I deals with the isotopic composition and the atomic properties of the element uranium and also with the occurrence and composition of uranium minerals. An account of the methods of extraction of uranium from ores and the preparation of the pure metals is given in Part II. The physical and chemical properties of uranium metal have also been described in detail in the same section. In this Part is included a brief survey of the mutual solubility of uranium and various metals and a description of some inter-metallic compounds of uranium. The next Part deals with the simple binary compounds of uranium such as hydrides, oxides, borides, carbides, silicides, sulphides, etc. Their methods of pre-

paration, physical and chemical properties and uses have been described. Part IV is devoted to the very important group of binary compounds of uranium, namely, fluorides, chlorides, bromides and iodides. The properties of uranium hexafluoride which is the only known stable gaseous compound of uranium have been described in some detail.

The book can be described as a review of the available "declassified" information on the subject. The review is neither critical nor complete, as a part of the information on basic uranium chemistry is still kept restricted. The references to the original papers and to project literature have been very exhaustive. The book is of very great interest not only to inorganic chemists but also to atomic physicists.

R. S. K.

The Interpretation of X-Ray Diffraction Photographs. By N. F. M. Henry, H. Lipson and W. A. Wooster. (Macmillan & Co., London). 1951. Pp. 258. Price 42 sh.

This book satisfies a long-felt need for a comprehensive treatise on the practice of X-ray crystallography. There are, of course, a number of works dealing with the principles of the subject; but with the exception of Buerger's book, none of them are really helpful to the practical worker. Buerger has, however, confined himself to moving film methods and to the precision determination of lattice spacings, to the exclusion of other methods. On the other hand, the book under review covers practically the whole gamut of techniques which are of general use at present.

The first three chapters deal briefly with crystal symmetry, the properties of X-rays and the derivation of Bragg's Law and its interpretation in terms of the reciprocal lattice. The remaining fourteen chapters are mainly devoted to the interpretation of various types of photographs. These deal not only with the determination of the unit cell and the methods of indexing the spots, but also with other techniques such as the study of orientation in single crystals, of preferred orientation and grain size in polycrystalline aggregates, measurement of intensities and the identification of materials by powder photographs.

The book abounds in charts and photographs; these are reproduced to scale and examples have

been set for being worked out. A large number of tables are included, mainly as appendices, so that it is unnecessary to refer elsewhere for any data. A novel feature of the book is the method of numbering figures and tables by means of the pages in which they occur, and this greatly facilitates cross-references. So also, the inclusion of references along with the author index is to be commended. But the numbering of sections is not so convenient; the use of three numbers, e.g., 10, 1. 6, may, no doubt, strike a familiar chord to the crystallographer accustomed to his *hkl*, but one is likely to forget the number of the sub-section by the time he has looked up the chapter and the section.

In spite of the excellence of the treatment, in so far as the subjects treated in the book are concerned, the reviewer cannot subscribe to the view that it is a suitable text book for a beginner to learn X-ray crystallography. A good amount of previous knowledge of the subject is assumed and it is surprising to find the topic of structure factors discussed for the first time only in Chapter 15. The result is that many statements in the earlier chapters, e.g., "The study of systematically absent reflections is essential in the determination of space-groups..." in 7, 5, 2 and "But it is clear that orders of 0001 occur only when $l = 3n$, and therefore a screw-triad axis must be present" in 10, 3, 3 are not readily appreciated. This is particularly so, because a discussion of what are space-groups or screw-triad axes is considered to be beyond the scope of the book. The reviewer hopes a brief account of space-group theory would be included in a later edition, so as to make the book more self-contained.

The printing and get-up are excellent, and there appears to be not a single typographical error in the whole book. The index, however, is not complete, for instance, it does not contain the reference to Lonsdale, 1947 b, found in pages 42 and 205 and "space-group" occurs in many more pages than are mentioned in the index, e.g., 100, 145, 149, 160, etc.

The book will prove to be an indispensable companion to the "general practitioner" of X-ray crystallography.

G. N. RAMACHANDRAN.

The Yeast Cell—Its Genetics and Cytology. By Carl C. Lindegren. (Educational Publishers, Inc., Saint Louis), 1949. Pp. xviii+365.

The author, who is a distinguished cytologist, has presented in this volume, a review of eight years' of his own pioneering studies on the genetical and cytological aspects of the Yeast

Cell. These researches have shown that the Yeast Cell is a conventional cell with chromosomes, nucleolus, heterochromatin, centrosomes and mitochondria. For the first time, the chromosome maps of the Yeast Cell have been constructed and new concepts of the nature of hereditary apparatus, developed. The author's views may be considered revolutionary and unorthodox from many points of view but he has raised many interesting points which would stimulate helpful controversy and lead to further progress in this difficult subject.

The work described in this volume has been made possible by the continued and generous support extended to the author by the famous Brewers, Anheuser-Buch Inc. The enlightened interest shown by this firm is in line with the tradition of breweries in Europe, like the Carlsberg Brewery, who have taken a keen interest in the promotion of investigations in pure sciences.

Modern Plastics. Second Edition. Revised. By Harry Barron. (Chapman & Hall, Ltd., London), 1949. Pp. xx+779. Price 50 sh. net.

The first edition of this extremely useful, highly informative and admirably introductive volume on modern plastics was written in 1944, on the eve of the Allied invasion of Europe, an event which highlighted in a vivid and spectacular manner, the vital and varied role played by plastics in the production of munitions. During the subsequent post-war years, the peace-time applications of plastics have been no less varied and extensive; the post-war period has witnessed not only the large-scale manufacture of plastics formerly considered as laboratory curiosities, but also a phenomenal expansion of the applications of plastics. To-day plastics which has attained the status of a major industry, is able to offer to the engineer and the technologist, a bewildering variety of materials of construction, possessing attractive and versatile properties. The introduction of plastics as a material of construction into industry, has served to conserve the strategically important metallurgical resources.

The author has taken advantage of the second edition to revise the subject and bring it up-to-date. The volume is divided into six parts and consists of 32 chapters dealing with the various aspects of the plastics industry—raw materials, manufacturing processes, plastic technology, machinery and equipment, applications of plastics, chemical and physical testing of the products.

The volume constitutes an excellent introduction to the subject of plastics, furnishing information and data of practical value and technological interest.

Fats and Oils; Soyabean and Soyabean Products, Vol. II. Edited by Klare S. Markley. (Interscience Publishers, Inc., New York), 1951. Pp. xvii+541-1145 and Figs. 83. Price \$11.00.

This, the second volume of the series on Fats and Oils, dealing with soyabean, may be considered a supplement to the first volume. Other equally important aspects of soyabean and its products have been dealt with in this volume.

Solvent extractions of oil is fast replacing the other expeller processes. But as originally adopted, solvent extraction led to serious fire hazards and application of modern methods has overcome the initial difficulties. Solvent extraction has now been developed to a high degree of perfection.

Soya lecithin, which is a by-product in solvent extraction, plays a very important role in many commercial and food industries. It is interesting to note that soya lecithin acts better than lecithin from other sources. The other important qualities of soya lecithin have been discussed from the standpoint of its utility for practical application.

The chapter on nutritional value of soyabean and soyabean products gives a comprehensive treatment of the value of fat in nutrition and how this fat could largely be met from soyabeans. In fact, the development of soyabean in U.S.A. to this extent is mainly based on its fat content.

These two volumes supply a long felt need in putting together work done in various laboratories on the different aspects of soyabean.

The book bears good illustrations of the various equipment used in soyabean processing industry. The get-up is as usual excellent, and the book is bound to benefit the research worker greatly.

S. S. D.

Advances in Carbohydrate Chemistry, Vol. V. Edited by C. S. Hudson and S. M. Cantor. (Academic Press Inc., New York), 1950. Pp. xi+322. Price \$6.80.

This addition to the earlier volumes of the series has a new pair of editors but the editorial policy has been the same, namely, to have individual contributors furnish critical, integrating reviews rather than mere literature surveys' in

the broad field of carbohydrate chemistry. The present report results from the efforts of fourteen contributors to ten reviews. These represent such a wealth of material of interest to the specialists as well as to the general chemist that a brief review could only serve by indicating the range of subjects covered. These include: Applications in the carbohydrate field of reductive desulfurization by Raney nickel (H. G. Fletcher and N. K. Richtmyer), Enzymic synthesis of sucrose and other disaccharides (W. Z. Hassid and M. Doudoroff), Enzyme specificity in the domain of carbohydrates (A. Gottschalk), Pectic enzymes (Z. I. Kertesz and R. J. McColloch), Crystallinity of the Celluloses (R. F. Nickerson), Commercial Production of Crystalline Dextrose (G. R. Dean and J. B. Gottfried), The Methyl Ethers of D-Glucose (E. J. Bourne and S. Peat), Anhydrides of the Pentitols and Hexitols (L. F. Wiggins), Action of Certain Alpha Amylases (M. L. Caldwell and M. Adams), and Xylan (R. L. Whistler).

The various chapters have been presented with remarkable clarity and conciseness and should save several hours of literature search to those engaged in related fields of work.

A. SREENIVASAN.

Industrial Oil and Fat Products. By A. E. Bailey. Second Edition. (Interscience Publishers, New York), 1951. Pp. vi+967. Price \$15.

The 1951 edition is in many ways a new and a thoroughly revised book with 217 additional pages of text and 53 more illustrations. The get-up and printing is of the same high standard as other books by Interscience Publishers.

The chapter on the reactions of fats and fatty acids has been brought up-to-date with fuller details, rancidity now occupies more than three times its former space, and information has been supplied regarding the now important spectral characteristics of oils. Amongst the new items mention must be made of data on hydrogenated shortenings, a review of the industrial applications of surface active agents and sections on the newer synthetic drying oils, co-polymerising materials and manufacturing operations in the varnish industry.

The bulk of the volume, however, is devoted to the technology of oil and fat industries in which the author describes the recent advances in industrial research on unit processes like solvent extraction, refining, bleaching, hydrogenation and deodorisation. To workers in India especially, this book will be of inestimable value.

S. A. SALETOR.

Books Received

- The Plant Glycosides.* By R. J. McIlroy. (M/s. Edward Arnold & Co.), 1951. Pp. 138. Price 18 sh.
- Parasitic Animals.* By Geoffrey Lapage. (M/s. Cambridge University Press), 1951. Pp. xxi+351. Price 21 sh. net.
- ABC of Agronomy.* By R. K. Misra. (Published by K. L. Misra), 1951. Pp. 121. Price not given.
- The Parasites of Domestic Animals.* By Thomas W. M. Cameron. (M/s. Macmillan & Co.), 1951. Pp. xvi+420. Price 38 sh. net.
- Hydroponics.* By J. Sholto Douglas. (Oxford University Press), 1951. Pp. xii+147. Price Rs. 6.
- Studies on the Natural Fats*, Vol. II, Part IV. By A. R. S. Kartha. 1951. Pp. 111. Price Rs. 2.
- The Chemistry and Technology of Food and Food Products*, Vol. II. By Morris B. Jacobs. (Interscience Publishers), 1951. Pp. xxvi+839-1769. Price \$15.00.
- Biochemistry and Physiology of Protozoa*, Vol. I. Edited by Andre Lwoff. (M/s. Academic Press), 1951. Pp. x+434. Price \$8.80.
- Styrene—Monomers.* By A. L. Ward, W. J.

- Roberts, E. R. Blout and H. Mark. (M/s. Interscience Publishers, Inc.), 1951. Pp. 126. Price \$3.50.
- Survey of Modern Electronics.* By Pant G. Andras. (Asia Publishing House), 1951. Pp. x+522. Price \$5.75.
- Theory and Design of Valve Oscillators*, Vol. VII. By H. A. Thomas. (M/s. Chapman & Hall), 1951. Pp. xv+317. Price 36 sh.
- The Intelligent Use of the Microscope*, Second Edition. By C. N. Olliver. (M/s. Chapman & Hall), 1951. Pp. xii+192. Price 15 sh.
- Atlas of Frambæsta.* By K. R. Hill, R. Kodijat and M. Sardadi. (World Health Organisation), 1951. Pp. 18. Price 5 sh.
- Carburation*, Vol. I, 3rd Edition. By Charles H. Fisher. (M/s. Chapman & Hall), 1951. Pp. xv+356. Price 36 sh.
- Patented Inventions of the C.S.I.R.*, 1951. C.S.I.R., New Delhi. Pp. 556. Price Rs. 15.
- Scientific Survey of Eastern Scotland.* (M/s. Macmillan & Co.), 1951. Pp. 207 + a map. Price 25 sh. net.
- The Neglect of Science—Essays Addressed to Laymen.* By F. E. Simon. (Basil Blackwell), 1951. Pp. v+138. Price 8 sh. 6 d.

INTERNATIONAL CHEMICAL CONCLAVE—1951

THE International Chemical Conclave was held in New York from the 3rd to 13th September, 1951. There were nearly 18,000 delegates representing over sixty nationalities. However, there were no representatives from the countries of Eastern Europe under Communist control.

The first five days of the conference were devoted to the 75th Anniversary of the American Chemical Society when the Priestly Medal was presented to Dr. E. J. Crane. During the session, many technical papers were presented.

The rest of the Conclave was devoted to the 12th International Congress of Pure and Applied Chemistry. Many sectional meetings were held during which a large number of technical papers was presented. The most outstanding paper of the Conclave was that submitted by Prof. Woodward of the Harvard University in which he described the synthesis of many of the important steroids including cholesterol, etiocholanolic acid and cortisone in their naturally occurring forms.

One special feature of the Conclave was the section on chemical education. Chemists as a whole, and specially in America, seem to be very much interested in evolving and improving suitable methods for teaching chemistry to students of various educational levels. In Orga-

nic Chemistry, for example, considerable emphasis is laid on the electronic interpretations of organic reactions. Physicochemical methods like spectroscopy are being extensively used for routine operations. Instrumental methods of analysis are replacing the usual chemical methods in many analytical procedures.

One novel feature of the Conclave was the congregation of younger chemists below forty years of age from various countries under the Younger Chemists' International Project. There were 261 participants from forty-eight nationalities, of whom eleven were from India. The necessary finance was provided for the Marshall Aid countries by the E.C.A. and the non-Marshall Aid countries by the Ford Foundation.

After the Conclave, the participants were divided into groups according to their interest and taken in conducted tours for three weeks in different parts of the States. During the tour, they had the opportunity to visit many institutions including Universities, Research Institutions, Government Laboratories and Industrial concerns.

Each participant in the Younger Chemists' International Project was also presented with \$100 worth of technical books by the American Chemical Societies.

S. C. B.

SCIENCE NOTES AND NEWS

International Pharmacopoeia

WHO is preparing an International Pharmacopoeia that will cover the most important medicines used throughout the world. When completed, the manual will consist of three volumes covering several hundred drugs. The first volume, already published, includes pain killers, sleeping pills, antimalarial drugs, sulfa drugs and other compounds for fighting infection, and the most important vitamins. It is expected that antibiotics and hormones will be covered in the later volumes.

Symposium in Chemistry

It is proposed to hold a symposium on *Chemistry of Hydrous Oxides* at the next Annual Session of the National Academy of Sciences, India, to be held in January, 1952. Dr. S. Ghosh, Reader in Chemistry, University of Allahabad, is expected to be the Chairman. Intending contributors are requested to send their papers accompanied by short abstracts by Air Mail immediately.

Award of Research Degree

On the recommendation of a Board of Examiners consisting of Prof. Kathleen Lonsdale, Dr. W. A. Wooster and Dr. R. Furth, the thesis entitled "Crystal Elasticity (Ultrasonic and other Methods)" by Mr. R. V. G. Sundara Rao, M.Sc., has been declared qualified for the degree of Doctor of Science in Physics of the Andhra University.

On the recommendation of a Board of Examiners consisting of Prof. Sir John Simonsen, Prof. R. P. Linstead and Prof. Sir Ian Heilbron, the thesis entitled, "Synthetic Experiments in Trihydroxy Flavones and Study of Some Flower Pigments" by Mr. N. Viswanandham, M.Sc., has been declared qualified for the degree of Doctor of Science in Chemistry of the Andhra University.

ISI—Fourth Annual Report

An important feature of the year's achievement which the Report records in detail was the growing recognition accorded to Indian standards by industry and Government Departments,

such as the Directorate-General of Industries and Supplies, the Railway Board, Directorate of Technical Development, Ministry of Defence and the Indian Posts and Telegraphs Department, which either adopted them in place of their older specifications or modified their purchase specifications by suitable reference to them. In the matter of laboratory facilities for tests, the Institution continued to receive active co-operation and assistance from all quarters in the country, and particularly from the laboratories of the Council of Scientific and Industrial Research, the Forest Research Institute, Dehra Dun, the Technical Development Establishment Laboratory (Stores), Kanpur, and the Government Test House, Alipore.

New subjects accepted for standardisation include transformers, chokes and wires used in radio industry, non-magnetic non-ferrous metals, wood poles, cast iron pipes, copper and brass tubes, wood screws, textile machinery, handloom cloth, sesame oil, groundnut oil, oil of peppermint, sodium stannate, potassium metabisulphite and phenyl.

In the international sphere the ISI is a member of the Council of the International Organisation for Standardisation (ISO), and the Director, Indian Standards Institution, is the Vice-President of the ISO.

Geological Mining and Metallurgical Society of India

The Twenty-Seventh Annual General Meeting of the Geological, Mining and Metallurgical Society of India was held in Calcutta, on 14th September, 1951. In his Presidential Address to the Society, Dr. West drew attention to India's recent work on the development of mineral resources of the Damodar Valley, and pointed out that progress so far achieved in this direction was largely based on the fundamental geological work carried out in the past. He, therefore, laid great stress on this type of fundamental geological work which must be carried out alongside work of more important practical significance.

Mr. B. P. Agarwalla, at present Vice-President of the Society, was elected President, and Professors N. N. Chatterjee and N. L. Sharma were elected Joint Honorary Secretaries of the Society for 1951-52.

Solar Eclipse Expeditions

Plans are being made for at least six expeditions which will make use of a total eclipse of the sun on February 25, next year, and a report on weather prospects has been prepared by a Commission of the International Astronomical Union.

The duration of totality will be 3.0 minutes, the belt of totality stretching from Equatorial Africa to the U.S.S.R. with the Nile Valley near Khartoum as the most favoured area.

International Industries Fair

The Bombay International Industries Fair will be held in December under the patronage of the Indian Government and under the auspices of the Engineering Association of India.

The Fourth Indian Pharmaceutical Congress

Arrangements are being made for the Fourth Session of the Indian Pharmaceutical Congress to meet in Jaipur during the end of December, 1951. The programme will include science session for the reading and discussion of research papers under five sections:

Pharmacy, Pharmacognosy, Pharmacology, Ayurvedic Medicines and Pharmaceutical Chemistry. A symposium on "Pharmaceutical Education" will be the special feature of this session.

Photosynthesis in the Laboratory

The process by which the plant uses solar energy to convert water and carbon dioxide into carbohydrates is believed to consist of two stages: photolysis of water and reductive fixation of carbon dioxide. The second stage is presumed to be catalysed by enzymes and a trace of manganese. A significant portion of this process of photosynthesis has been reproduced in the test tube, according to a report on work by Prof. D. I. Armour of the University of California. Pyruvic acid was converted to malic acid and oxygen was evolved, exactly as occurs in plants. The catalytic role of manganese in the reaction confirms previous theories of its importance as a trace element in the soils. The achievement may be a long step towards a scientific advance that would be fully as important as the achievement of nuclear fission.

Inter-Commonwealth Post-Graduate Scholarships in Science

The above-mentioned publication, compiled by B.C.S.O. and published by H.M. Stationary Office,

is a comprehensive list of post-graduate scholarships available for scientific study within the Commonwealth. The main object of the list is to encourage the movement of scientists within the Commonwealth, and only those awards open to members of at least one Commonwealth country or colony other than the awarding one have been included. The price of the publication is 5 sh. and copies are available at all branches of H.M. Stationary Office.

Penicillin Manufacture in India

The Draft Agreement between the Government of India on the one hand, and WHO and UNICEF on the other, for the manufacture of penicillin in India, has been finalised. It is proposed that the penicillin factory should be located in the Poona District.

The factory will be entirely owned and controlled by the Government of India, and UNICEF will supply all the imported equipment, estimated at 850,000 dollars.

Other clauses of the agreement are that WHO will provide technical assistance and also arrange for the training of Indian personnel at an approximate cost of 350,000 dollars. WHO will award Fellowships for advanced training in connection with the operation of the plant. Production is likely to start in December, 1953, while full production is likely to be reached about a year later.

Dr. B. Mukerji

Dr. B. Mukherji, Director, Central Drug Research Institute, has been elected a Member of the Scientific Research Society of America. He has been invited as an expert to serve on the Advisory Panel of the International Pharmacopoeia.

International Technical Cooperation

Under the various schemes of technical assistance from foreign countries, India has so far obtained 32 experts and trainee facilities for 247 persons. The experts and the facilities have been made available to India under (a) the point-four agreement with the United States of America, (b) the Technical Co-operation Scheme of the Colombo Plan, and (c) by the specialised agencies of the United Nations. In fulfilment of her obligation as a member country of the Colombo Plan, India has also sent some of her own experts to foreign countries. Offers of training facilities have been made to Ceylon, Nepal and Pakistan.

Scientific Apparatus

OF HIGH PRECISION & ACCURACY

FOR COAL & GAS TESTING:

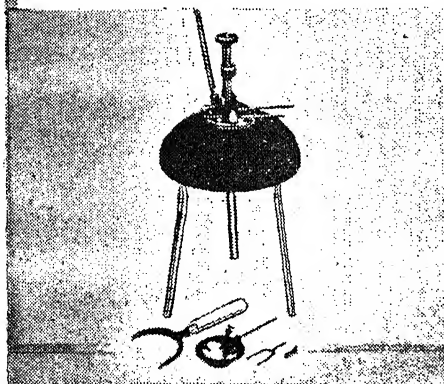
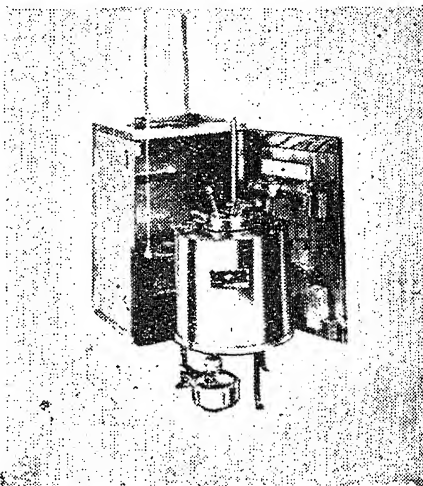
- ★ Bomb Calorimeter, Malher Cook
- ★ Roland Wild Calorimeter

FOR METALLURGY.

- ★ Reichert's Metallurgical Microscope "MeN"
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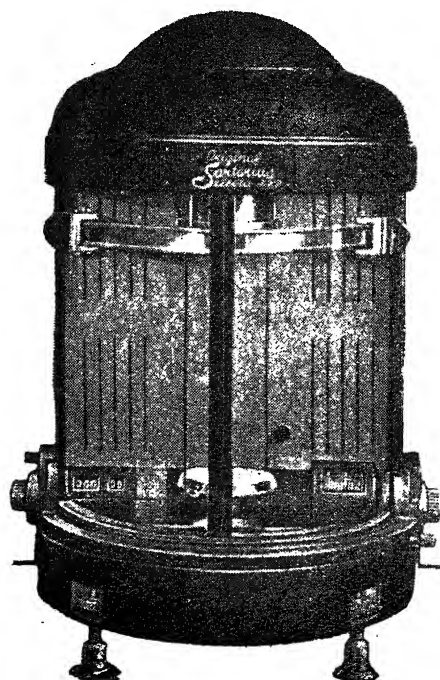
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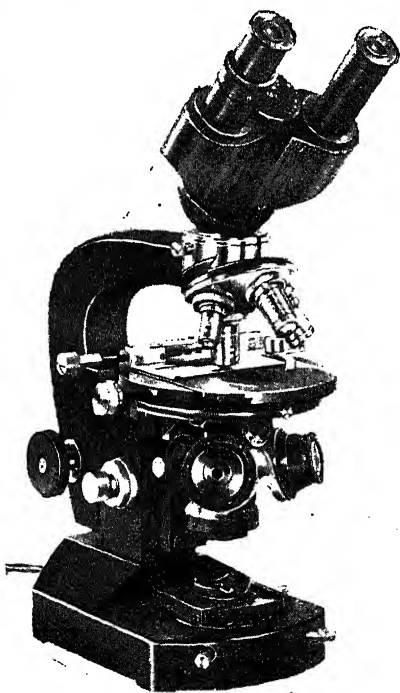
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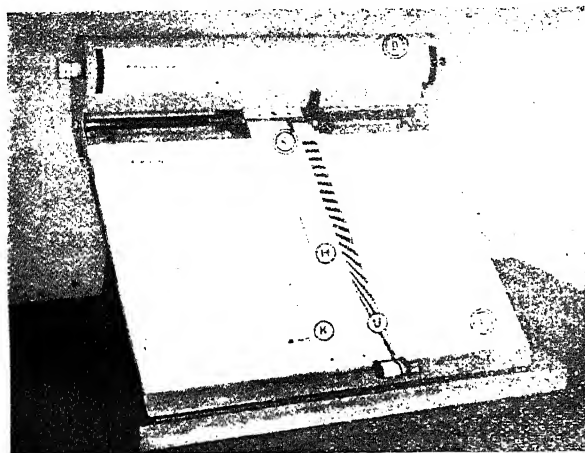
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SCIENTIFIC PUBLICATION IN INDIA

A BIBLIOGRAPHY of scientific journals recently issued by the UNESCO contains nearly 200 titles of publications from India. A perusal of the list will show that the journals are quite extensive in range and cover almost all the important branches of scientific research. On the face of it, therefore, the position regarding scientific publications in our country might appear to be satisfactory; but in fact the situation does not warrant any such complacency on our part, for the vast majority of the journals are rather seriously handicapped by lack of proper finances.

At present, it is rarely the case that a society sponsoring a scientific journal is also in a position to meet fully the cost of its publication. The subscription rate has necessarily to be kept low so as to have a reasonable circulation, and the deficit has to be made up partly from advertisements, but mainly by subsidies from the Government. Some journals also receive grants from universities and other philanthropic institutions. While it is laudable that such support is available, it restricts the activities of the journal in many ways. Firstly, the grants are mostly made on an yearly basis only. Also, the

continuance of the grants is never definitely assured so that any long range planning becomes difficult. Naturally, the selection of subject-matter for publication has to be decided not only by its quality, but also by the availability of space, which is restricted by financial considerations. Thus, many articles which would otherwise be perfectly suitable for publication have to be returned because of this factor.

A similar situation existed also in the case of the journals of the U.S.A., particularly on account of the heavy pressure on space due to the widely expanded research programme during and after the war. The solution which has been devised by them seems to be perhaps the best under the circumstances. Finding that the volume of matter deserving publication far exceeded their resources, the American Journals are charging a good percentage of the cost of publication to the *institutions themselves* who forward these articles, reprints being supplied to them free of cost. This solution seems to be perfectly just and reasonable, for it will readily be admitted that publication is an integral part of every research programme and any finance set apart for the programme should also include the cost

of publication and reprints. In this connection, it is interesting to read the following statement by the American Physical Society: "It is gratifying that with few exceptions, the articles published in all American Physics Journals now receive this institutional support which makes possible publication of a considerable number of pages of scientific material which otherwise could not appear." It hardly needs to be emphasized that a similar procedure, if also adopted in our country, would greatly improve the financial position of the journals.

Apart from these considerations, the introduction of such a procedure would also lead to various other improvements. One obvious defect that is noticed in many of our journals is that the quality of the articles accepted for publication is not as high as would be desirable. This is mainly due to the fact that there is a great tendency on the part of research workers to rush into print every new result, without waiting to consolidate the position. Also, where a paper is particularly good, a report of it is sent abroad for publication in preference to journals in India. This arises mainly from two causes; firstly, since the circulation of many of our journals is not large enough, an important contribution published therein is quite likely to be overlooked; and secondly, the time of

publication is also long, and often not definite.

Under these circumstances, the suggestion that the institutions should pay for the cost of publication would go a long way towards removing these difficulties. Clearly, when the financial position of the journal improves the time of publication can also be made quite short, and this should induce good papers being sent for publication to journals in India instead of abroad. Once the standard of our journals is raised, there is bound to be a larger demand for them abroad and in this way the circulation would automatically shoot up. Further, if it is necessary to pay for the publication, there would be a preliminary selection of material at the source itself, so that the quality of the articles received for publication would improve considerably.

There is, however, a definite class of scientific journalism which is apparently unrepresented in India, *viz.*, semi-popular expositions of scientific results, as in the *Scientific American*, *Science et Vie* or *Discovery*. This class of journalism has a vital role to play in keeping the general public abreast of the latest developments in science and helping them to take an active interest in its progress, which obviously is the only way of obtaining adequate public support for scientific research.

NOBEL AWARDS FOR PHYSICS AND CHEMISTRY, 1951

THIS year's Nobel Prize for Physics has been awarded jointly to the British Physicists, Sir John Cockroft, Director of the Atomic Research Establishment at Harwell and Prof. E. T. S. Walton, of Dublin University, in acknowledgment of their fundamental work on the transmutation of elements. Working at the Cavendish Laboratory, Cambridge, under the direction of the late Lord Rutherford, Cockroft and Walton produced the first artificial transmutation of an element in 1932 by bombarding lithium by means of protons accelerated to a voltage of more than one million volts in a special cascade generator constructed by them. Lithium was thus converted into two α -particles. They also succeeded in transmuting a number of other elements, *e.g.*, boron to beryllium, fluorine to oxygen, sodium to neon, etc. This was the starting point of a new field of nuclear physics and was followed by the construction of larger and more powerful accelerators, such as the van der Graaf generator, the cyclotron

and the synchrotron, and ultimately by the well-known developments leading to the release of atomic energy. While these atom smashing machines were used in the early days for the production of new isotopes of known elements, they have recently been able to produce new elements themselves.

Appropriately enough, the Nobel Prize for Chemistry has been awarded jointly to Profs. Seaborg and Macmillan of the California University who have played a notable part in the discovery and study of these new transuranic elements. They and their co-workers have definitely identified five such elements, Neptunium (93), Plutonium (94), Americum (95), Curium (96) and Berkelium (97) and also studied their chemical properties, isolating them in a pure state by ultramicrochemical techniques. None of these elements have been found to occur in nature, because all their isotopes have relatively short half-periods and they are therefore rightly termed "synthetic elements".

THE INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

THE Thirty-ninth Annual Session of the Indian Science Congress is being held at Calcutta during the first week of January, 1952. Dr. J. N. Mukherjee, one of Professor Donnan's "three musketeers", distinguished for his pioneering work in the field of colloid chemistry, at present the Director of the National Building Research Institute at Roorkee, is the President-elect of the Session and will preside over the meetings. Prime Minister Jawaharlal Nehru is expected to address the delegates.

A distinguished delegation of visiting scientists will attend the Session and actively participate in the proceedings. So far as we know, the delegation includes Dr. William A. Soileman, Professor of Clinical Tropical Medicine, Louisiana, Dr. Jasper H. Kane, the discoverer of Terramycin and Director of Biochemical Research and Production of Chas. Pfizer Co. Inc., New York, Dr. Charles A. Werner of Chas. Pfizer & Co., New York, Prof. J. C. Werner, President, Carnegie Institute of Technology, U.S.A., Dr. G. W. Rake, Director, Squibb Institute of Medical Research, U.S.A., Dr. P. Evans, Geologist of the Burmah Oil Co., London, Dr. E. C. Bullard of the National Physical Laboratory, Teddington, Dr. Dupouy, Director of National Centre of Scientific Research, Paris, Dr. Erwin Brand, Paris, Dr. J. M. Trepod, Chief of Pharmacological Laboratory, Ciba, Berne, Professor Arthur Stoll, President, Council de la Chimie, Basle, Switzerland, and Professor J. B. S. Haldane, England. The delegation consists mostly of biochemists, medical men and leaders of pharmaceutical industry.

During the Session, no less than forty symposia covering a large number of subjects, are

scheduled to take place. Most of the subjects chosen are reminiscent of the titles of well-known treatises on the subject. It is doubtful if it would be possible to do justice to the formidable array of the topics chosen for discussion. It is generally feared that such ambitious programmes usually result in diffuse, amateurish and inconsequential discussions. It may, therefore, be advisable to arrange for a more modest programme comprising subjects of topical value and realistic significance. It would then be possible to bestow deeper thought on the subjects and thereby, enhance the prestige and scientific value of the proceedings.

It is generally felt that the time has arrived when the scope and functions of the Indian Science Congress should be thoughtfully reviewed. With the establishment and growth of the Academies and several specialist scientific societies representing different branches of science, it may perhaps be desirable that the Indian Science Congress should orient its activities in a manner which does not duplicate the efforts of the other organisations.

The Indian Science Congress Association, the oldest of our science organisations in the country, represents not only men of science but also those interested in the advancement of science. The Association with such a cosmopolitan and liberal outlook, is eminently fitted to carry the message and teachings of science to the people of our great subcontinent. We have no doubt that this question which has been engaging the attention of many of our leaders in science, will be discussed at the policy meeting of the Indian Science Congress Association.

INFLUENCE OF ANTIBIOTICS ON THE GROWTH OF SILKWORMS

IT has been found that antibiotics, particularly aureomycin and chloromycetin, enhance the rate of growth of silkworms. An increase in the larval weight amounting to 15 to 20 per cent. at maturity, has been obtained with worms dosed with antibiotics. The worms treated with antibiotics look healthier, moult easily and regularly, possess a keener appetite and exhibit greater activity. A more efficient utilisation of the feed is secured by means of these antibiotics and the retention of the leaf and supplemented nitrogens, is greater in the case of worms dosed with aureomycin and chloromycetin. There was also a 10-15 per cent. increase in the yield

of silk. Terramycin which was also tried, was found to have relatively little effect on the growth of the worms.

Experiments both at the Indian Institute of Science and at the Govt. Experimental Sericultural Farm, Government of Mysore, with the foreign races of silkworms which are particularly susceptible to diseases—flacherie and grasserie—showed that when the Japanese multivoltine race (N-112) is dosed with chloromycetin, the worms do not suffer from any of the diseases while among the untreated batches, the disease incidence amounted to 20 per cent.

'X-RAY MICROSCOPE' EMPLOYING LAUE REFLECTIONS

By G. N. RAMACHANDRAN AND Y. T. THATHACHARI

(Department of Physics, Indian Institute of Science, Bangalore 3)

PRINCIPLE OF THE METHOD

THE refractive index for X-rays is very nearly equal to unity, so that refractive focussing of X-rays by lenses, as for ordinary light, is practically impossible. However, total reflection of X-rays takes place at small glancing angles (of the order of a few minutes of arc for ordinary wavelengths)¹ and utilising this phenomenon, X-ray focussing devices have been constructed.^{2,3} Since the image obtained from a single concave mirror is highly astigmatic, two mirrors with their planes of reflection at right angles are employed, and images, having a magnification of upto 30 with a field of view of about 0.5 mm. have been obtained. Kirkpatrick⁴ has also suggested a possible method of refractive focussing, which has not been tried, but does not appear to be promising owing to the large absorption in most materials.

The present note deals with a new method of obtaining focussed images, utilising the Laue reflection from crystallographic planes. As its very name implies, the Laue reflection obeys the optical laws of reflection with respect to the plane concerned; but it differs from ordinary reflection in that for a particular angle of incidence θ only a small range of wavelengths near selected values, given by the well-known formula $n\lambda = 2d \sin \theta$ will be reflected. Thus, if white X-rays are incident on a thin cleavage flake, a portion of the rays would be reflected in the same direction as ordinary light would be, if incident on the same angle as the X-rays. Suppose now that the lattice planes in the crystal are bent into the form of a concave spherical surface, and that we have a point-source of X-rays along the axis of the "concave mirror". Then, a certain fraction of the incident X-rays would be reflected and *the whole of this* would converge again to a point. Thus, an enlarged or diminished image is formed by X-rays at exactly the same place as the optical image obtained by illuminating the object with ordinary light. Apart from the aberrations of the mirror, the only contributor to the "background illumination" of the image is the Compton scattering from the crystal flake, which is comparatively weak, being incoherent.

EXPERIMENTAL ARRANGEMENT

The above ideas were tested by means of a very simple experimental arrangement. The

essential part is a crystal plate, whose lattice planes have been distorted to form the surface of a sphere. This is obtained as follows: A thin cleavage strip of mica M (0.04 mm. thick) is fixed by means of wax on the circular brass flange F of a tube of inner diameter 1 inch (Fig. 1). On evacuating the inside of the tube,

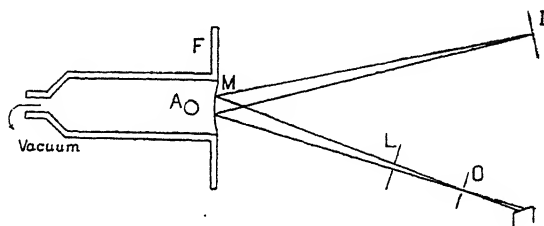


FIG. 1. Schematic Diagram of the Experimental arrangement.

the mica curves inwards, and if the central portion alone is utilised, then a fairly good optical image is obtained employing the mica as a mirror. In this way, a radius of curvature as small as 15 cm. (focal length 7.5 cm.) could be obtained. The difference of pressure on the two sides of the mica was of the order of 40 cm. Hg. The object O employed was a 100 mesh brass wire net, kept on an aperture in a lead screen. A lead aperture, L, was used to limit the beam diverging from O. The photographic film for recording the image I can be fixed on a stand sliding along an arm AI, which rotates about an axis A, which is also the axis of rotation for the tube bearing the mica mirror. Initially, the whole arrangement is removed from near the X-ray tube, the wire mesh is illuminated by ordinary light and the distances OM and MI suitably adjusted to get an image of the required magnification on a ground glass screen at I, to one side of the object. The arrangement is replaced near the X-ray tube and a photographic film is placed in the same position as the ground glass plate. With an ordinary demountable copper target X-ray tube working at 40 KV and 15 ma, exposures of the order of 30 min. are needed for a magnification of 4 and of the order of 6 hours for a magnification of 20.

RESULTS

Three photographs obtained in this way are reproduced in Fig. 2 a, b, c. They are all contact

prints of the X-ray films and the magnifications are indicated in the caption to the figure. Fig. 2a shows that with a small field of view, the image is quite sharp and almost undistorted. The field of view in Fig. 2b is fairly large of the order

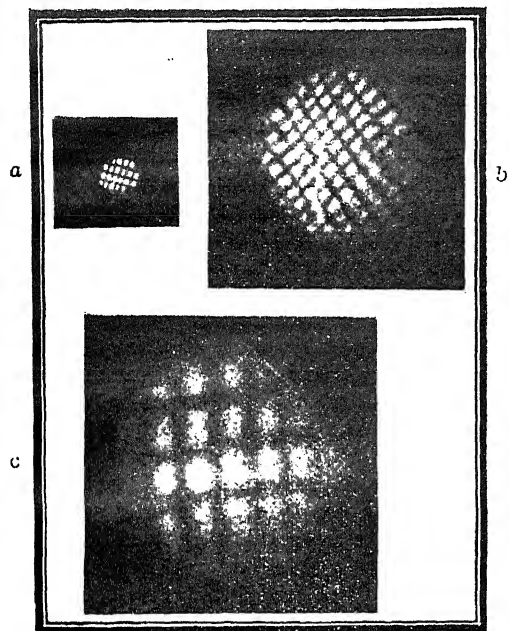


FIG. 2. Magnified images of a 100 mesh brass wire net, obtained by X-rays. The magnifications are for (a) $\times 3\frac{1}{2}$, (b) $\times 6$, (c) $\times 20$.

of 2 mm. diameter; but there is a certain amount of distortion owing to the unevenness of the mica surface. Efforts are being made to modify the technique of bending the mica to get rid of this. It is to be noted that the image is sharp even at a magnification of 20 (Fig. 2c). In all the figures, the magnifications in the vertical and horizontal directions are not equal because the image is to one side of the object.

Thus, it is clear that the new method of obtaining enlarged photographs with X-rays is workable and the exposures are not too large. The theoretical resolving power of this method is much larger than for the method employing total reflection. In the latter case, the limit of resolution is estimated to be about 3,000 Å for X-rays of wavelength about 1 Å.⁵ Here, it should be very much smaller than this, if spherical aberration is made small, because diffraction alone would lead to a value of the order of the wavelength of X-rays. Therefore, it is necessary to devise suitable methods whereby the lattice planes could be curved to such a surface as to reduce spherical aberration. Two other possible

methods of curving a crystal plate into a concave surface may be mentioned, though neither has yet been tried. One is to bend a circular plate pressed by means of two concentric rings from either side and the other is to deform it plastically to the required surface. The former is suitable for quartz and the latter for rock salt.

In any case, there seems to be little doubt that the design of the "X-ray microscope" considered here will have a resolving power better than that of the optical or ultra-violet microscope. Unfortunately, however, it does not appear to possess a large magnifying power. The focal length cannot be made less than about 5 cm., so that even a magnification of 50 in one stage would require a distance of 2.5 metres between the mirror and the photographic film. Higher magnifications in a single stage are thus ruled out. When we consider combinations of two mirrors as in a reflection microscope, a complication arises because in a Laue reflection, the wavelength of the ray reflected from the first mirror depends on the angle of reflection, and this has again to be incident at exactly the same angle on the second mirror. However, this strict condition can be satisfied by a combination of two annular mirrors with their axes coincident, but the theoretical study shows that the magnifications m_1 , m_2 of the two mirrors are not independent. The total magnification $M = m_1 m_2 = m_1 (2 - 1/m_1)$, so that $M \leq 2m_1$. Thus there is not much of an advantage in such a combination, in so far as magnification is concerned. However, it has the merit that the image is now along the axis and thus, there is no difference in the magnification in two perpendicular directions, as is the case with a single mirror.

Thus this instrument is not a suitable one for obtaining a very large magnification; however by using moderate magnification with X-rays and having further stages of enlargement optically, it is possible to obtain a resolving power better than the optical microscope. So also the greater penetration of X-rays would enable it to be used in circumstances where the electron microscope is inapplicable because of heavy absorption.

1. Compton, A. H., *Phil. Mag.*, 1923, 45, 1121. 2. Kirkpatrick, P. and Baez, A. V., *Journ. Opt. Soc. Am.*, 1948, 38, 766. 3. Lucht, C. M. and Harker, D., *Rev. Sci. Instr.*, 1951, 32, 392. 4. Kirkpatrick, P., *Journ. Opt. Soc. Am.*, 1949, 39, 796. 5. Prince, E., *Journ. App. Phys.*, 1950, 21, 698.

THE ADSORPTION OF SYNTHESIS GAS AND ITS COMPONENTS ON FISCHER-TROPSCH CATALYSTS

J. C. GHOSH AND M. V. C. SASTRI

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THE Fischer-Tropsch Process for the commercial synthesis of liquid hydrocarbons from modified water-gas is, perhaps, one instance of a technical chemical process in which interest in the reaction mechanism went almost *pari passu* with its industrial development. Ever since its discovery in 1926, the mechanism of the reaction, with special reference to the function of the catalyst, has been the subject of considerable controversy.

In the reaction mechanism originally proposed by Fischer and his co-workers¹ and later extended by Rideal² and Craxford,³ it was postulated that metallic carbides were formed as intermediate products out of the chemisorbed carbon monoxide and that these were reduced by the gaseous hydrogen present to form methylene groups which in turn link up to form the paraffin chains. Matsumura⁴ slightly modified this hypothesis by suggesting that chemisorbed hydrogen was required to reduce the carbide to methylene radicals.

On the other hand, Elvins and Nash⁵ proposed that carbon-hydrogen-oxygen complexes were more probable than carbides as intermediates in the Fischer-Tropsch synthesis, since oxygenated compounds were always found in the final products along with the hydrocarbons. Hamai⁶ suggested a similar mechanism according to which enolic complexes were formed on the surface by the interaction of adsorbed carbon monoxide with adsorbed hydrogen.

Investigations carried out during the past three years in the United States of America⁷ have produced a considerable volume of evidence to disprove the carbide hypothesis and all its affiliations. Instead, the alternative proposal of an adsorbed reaction complex of carbon monoxide and hydrogen seems to be gaining support.

Both schools of thought, however, accept the importance of the adsorption, or rather the chemisorption, of the reactant gases as a vital step in the formation of the active substrate. The controversy arises mainly with regard to the subsequent transformation of this substrate under synthesis conditions: whether it enters into a reaction with the catalyst metal and thus gets fixed as carbide, or whether the adsorbed molecules interact with each other so as to form

C-O-H complexes chemisorbed on the surface. It is evident that a considerable knowledge on this aspect of the controversy could be derived from a systematic study of the adsorption of the reactant gases, more especially from their mixtures, on the catalysts, at temperatures progressively approaching, without yet reaching, the minimum temperature of appreciable reaction.

Such studies were initiated in the General Chemistry Laboratories of the Indian Institute of Science, Bangalore, in 1945 and the results so far obtained with cobalt catalysts are indeed interesting and informative. The first two catalysts studied had the compositions: (A) Co 34%, Cu 4%, ThO₂ 2.33%, Ce₂O₃ 0.24% and the rest kieselguhr, and (B) Co, Cu, ThO₂ and Ce₂O₃ same as in (A) plus 4% Cr₂O₃ and the rest kieselguhr. Brief reports of these investigations have appeared in this journal and elsewhere⁸ and a more detailed account was presented before the Division of Fuel, Gas and Petroleum, of the XIIth International Congress of Pure and Applied Chemistry held at New York in September last.

On these catalysts, the individual adsorptions of carbon monoxide and hydrogen were studied at a series of temperatures not only from the pure gases but also from 1 CO : 1 H₂* and 1 CO : 2 H₂* mixtures at temperatures ranging from 25 to 97° C. The adsorption studies from the mixtures were made with the aid of a thermal conductivity meter, specially designed for quick response and small dead space. The thermal conductivity measurements were also unaffected by pressure variations between 10 and 80 cm. At the maximum temperature at which measurements were made of mixed adsorption, namely, 97° C., it was verified by thermal conductivity reading as well as by independent chemical analysis, that the gas pumped out of the adsorption tube was free from traces of hydrocarbons, water and carbon dioxide. In general, the results appeared to be the net resultant of two opposing effects, namely, (1) a mutual suppression of the adsorption of each gas as would normally be expected from the Langmuir Theory⁹ and (2) an enhancement of the adsorp-

* These denote the initial compositions of the gas admitted.

tion of either constituent due, in all probability, to interaction and complex formation in the substrate.

It is quite possible for the two effects to take place simultaneously on different parts of the surface. Since chemical complex formation would require an activation energy, there would be negligible complex formation at low temperatures and the net result would be a suppression of the adsorption of one gas in the presence of the other. As the temperature increases, however, substrate-interaction or surface complex formation takes place to an increasing extent with the result that at a certain temperature (still below the reaction temperature) the adsorption from mixtures surpasses that determined at the same temperature and at equivalent pressures from the pure gas. This has been found to be the case with the adsorption of carbon monoxide on catalyst A and of hydrogen on catalyst B. In either case, the adsorption from the mixtures up to 76° C. was lower than that from the respective pure gases, while at the higher temperature, 97° C., there was a pronounced increase in the adsorption of either gas, relative to the pure gas isotherms. The adsorption of hydrogen from mixtures on catalyst A was found to be markedly higher than the pure gas isotherms, even at the lowest temperature studied, namely, 25° C., indicating that at a still lower temperature the suppression effect would have become evident.

On both catalysts it has been observed that the adsorption of each constituent commenced to increase with temperature at much lower temperatures than in the absence of the latter. In other words, when compared with the adsorption isobars of the pure gases, the positions of minimum adsorption of the same gases from the mixtures were, as a rule, shifted substantially to lower temperatures. For instance, the isobars for the adsorption of pure carbon monoxide passed through a minimum at ca 90° C.; this minimum was shifted to ca. 50° C. when the adsorption of carbon monoxide took place from 1 : 1 mixture.

A further interesting observation was made with catalyst B. When the simultaneous adsorptions of the constituent gases were plotted against each other, the 'isotherms' so obtained tended to become linear especially at the higher temperatures. At 97° C., after an initial equimolecular adsorption of either gas, the respective adsorptions increased further in the proportion of 2 CO : 1 H₂, even from mixtures con-

taining 3 to 10 times as much hydrogen as carbon monoxide at equilibrium.

These observations, taken together, point to the possibility of a progressive formation of CO-H complexes on the surface of the cobalt catalysts, under conditions approaching those required for the synthesis of hydrocarbons. Furthermore, observation of the kinetics of mixed adsorption, facilitated by the use of the thermal conductivity meter, indicated a progressive replacement of part of the initially adsorbed hydrogen by carbon monoxide in the course of the formation of these CO-H complexes.

Independent corroboration of the results of mixed adsorption on catalyst B was received from experiments¹⁰ in which the effect of the prior-adsorption, or 'pre-sorption', of each gas on the adsorption isotherms of the other was determined at 52°, 76° and 97° C., employing the technique of Griffin.¹¹ While small amounts of hydrogen presorbed on the catalyst led to a marked enhancement of the adsorption of carbon monoxide at all the temperatures, the effect of a pre-sorption of carbon monoxide was to lower the hydrogen adsorption. As a rule, the adsorption of each gas on the catalyst, pre-treated with a given (small) dose of the other, increased with temperature, so that it could reasonably be expected that the adsorption of hydrogen on the "poisoned" surface would, at a few degrees above 97° C., exceed the value found on the clear surface.

Some interesting experiments have just been carried out¹² which indicate the absence of any extensive amounts of carbide on the surface of a cobalt catalyst under synthesis conditions. In these studies, synthesis and carburization runs alternated with measurements of the surface area and CO-chemisorption at low temperature. The latter is generally considered to represent a measure of the free, exposed, cobalt on the surface.¹³ Synthesis gas was passed over an active cobalt catalyst, while the temperature was gradually raised from 150° C. to 190° C. As soon as the volumetric contraction reached 70%, the catalyst was flushed with nitrogen at 200° C. to remove physically sorbed vapours and further degassed by evacuation at the same temperature. The value of the CO-chemisorption obtained for the catalyst after this treatment was 75% of the value found for the fresh catalyst after reduction and prolonged evacuation at 300° C. This clearly demonstrates that at least 75% of the substrate in synthesis could be 'cleared' by evacuation at the reaction temperature. That this could not have happened had

there have been any extensive carbiding of the catalyst, was shown by another experiment in which the catalyst was deliberately carburized by passing carbon monoxide for nearly 32 hours at 200° to 250° C. Evacuation at 300° C., after this treatment, did not restore more than 25% of the original value for the chemisorption of carbon monoxide. The carbided catalyst was also found to be almost inactive in hydrocarbon synthesis. Only a little methane, but no higher hydrocarbons, was produced, possibly by the slow reduction of the carbide by the hydrogen present.

These researches, concerning the nature of the active substrate in the Fischer-Tropsch reaction lead to the conclusion that a chemisorbed complex of the reactants, such as CO-H, rather than a metal carbide, is the intermediate precursor to -CH₂- groups. This view places us in agreement with the results of two recent investigations reported from the U.S.A. Employing the 'tracer' technique, Kummer, *et. al.*,¹⁴ have shown that "either ethyl alcohol or some surface complex formed by the adsorption of ethyl alcohol behaves as an intermediate in hydrocarbon synthesis over iron Fischer Tropsch cata-

lysts and that at least the first of the added carbon atoms attaches itself principally to the α -carbon atom of the surface complex". Drawing a parallel between the formation of branched chain hydrocarbons and that of branched chain alcohols in an operating Fischer Tropsch unit, Weitkamp¹⁵ concludes that the same mechanism operates in both cases.

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OIL REFINERY TO BE ESTABLISHED IN BOMBAY*

DURING his recent visit to the U.S.A. and U.K., Dr. Bhatnagar, who was entrusted with the task of exploring the oil refinery problem, held discussions with the Standard Vacuum Oil Company and Caltex in New York, and with the Burmah Shell and B.O.C. in London. These companies showed their willingness to start oil refineries in India and discussions were continued in India after his return. The proposal which has now been accepted by the Government of India is the result of this discussion. According to the agreement signed on November 30, the Standard Vacuum Oil Company of New York will instal a million ton oil refinery at Trombay, near Bombay.

To facilitate the project, the Government of India have given certain assurances to Standard Vacuum, including exemption from compulsory acquisition for a period of 25 years and exemption from certain provisions of the Industries (Development and Regulation) Act. Standard-

Vacuum on their part have assured Government that the refinery would be completed as early as possible, that an adequate number of Indian personnel will be trained in refinery operations for employment in the refinery and that byproducts of the refinery will be made available for subsidiary Indian industries.

The Company has already brought out to India a group of marine engineers and refinery experts who will collaborate with the Government of Bombay and the Bombay Port Trust officials for the necessary improvements in the dock and harbour facilities near the site where the refinery would be set up, and for the solution of other preliminary technical problems. The company hopes to bring the refinery into actual production within four years.

This is the first instance in which large-scale foreign investment is coming to India with a view to setting up a vital, new and complicated industry. Discussions are at the moment proceeding with other oil companies which may lead to additional refineries being established.

* By courtesy of Sri. B. N. Sastri, Chief Editor, Publications Division, C.S.I.R., Delhi.

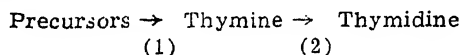
METABOLIC INTER-RELATIONSHIPS BETWEEN FOLIC ACID AND VITAMIN B₁₂

A. SREENIVASAN

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SEVERAL recent reports indicate that folic acid and vitamin B₁₂ have more or less defined biochemical functions other than their established involvement in hæmopoiesis. However, there has been no direct experimental proof hitherto of specific enzyme systems associated with either vitamin and regulating cellular metabolism. The fact that folic acid and vitamin B₁₂, despite their dissimilarity from a chemical standpoint, should function so inter-relatedly in diverse processes would only make such studies more intriguing.

Among systems known to be influenced by the two hæmatinics may be mentioned those involved in (i) the oxidations of purines, choline, glycine and D-amino acids, (ii) the metabolism of tyrosine, serine and glycine, (iii) nucleic acid biogenesis, and (iv) trans-methylations. Relevant literature has been cited in recent publications from this laboratory.¹⁻⁵ An explanation of the observed metabolic inter-relationships between the two vitamins has been sought for on the basis of the following well-known synthetic step in nucleic acid metabolism:



in which steps (1) and (2) are catalysed respectively by folic acid and vitamin B₁₂. Indeed, clinically and biochemically, such a step could be taken as having been established unequivocally.⁶ Nevertheless, this inter-relationship would seem obviously insufficient to account for the other apparently unrelated enzyme systems enumerated above.

Unpublished data (referred to in¹) have indicated that plasma levels of folic acid as well as stored folic acid in livers of experimental chicks are influenced by dietary vitamin B₁₂ fed as condensed fish solubles especially at low levels of folic acid ingestion. Typical results are summarised in Table I.

This potentiating effect of vitamin B₁₂ on the mobilisation of folic acid has since been confirmed with crystalline vitamin B₁₂.⁸

It is pertinent to refer here to certain significant observations on the metabolic economy of folic acid. Micro-organisms which synthesize their own requirement of folic acid from precursors elaborate this vitamin largely as folinic acid or the *citrovorum factor*⁴ which is undoubtedly

TABLE I
Influence of Vitamin B₁₂ on the Utilization of Dietary Folic Acid

Dietary folic acid (<i>gamma</i> per cent.)	Without iodinated casein		With 0.03% iodinated casein	
	Basal diet	Basal diet + 3.0% fish solubles	Basal diet	Basal diet + 3.0% fish solubles
Blood folic acid (<i>gamma</i> per 100 c.c.)				
0	0.30	0.38	0.30	0.43
10	0.36	0.46	0.35	0.49
50	0.46	0.55	0.36	0.49
200	0.84	1.10	0.60	0.95
Liver folic acid (<i>gamma</i> per g.)				
0	1.31	1.77	1.34	2.15
10	1.70	1.93	1.48	1.96
50	1.93	2.23	1.75	1.83
200	3.42	3.63	2.80	2.78

Day-old chicks, ten to a group, were employed; the basal diet was a purified dextrin-casein ration as given in⁷ with the substitution of pure corn dextrin for sucrose. Data above relate to samples at end of four weeks.

the physiologically more active form of folic acid;² folinic acid is the form present both in the cells and in culture filtrate. On the other hand, organisms requiring exogenous folic acid for growth do not synthesize appreciable folinic acid activity in culture filtrates whereas the folic acid taken in the cells is present as folinic acid (unpublished data). Likewise, stored folic acid in rat liver which is nearly equally distributed between the particulate and supernatant fractions exists almost entirely as folinic acid.⁹ A similar intracellular distribution pattern for vitamin B₁₂ would show that it is concentrated in the mitochondria. These findings suggest that folinic acid is dynamic and functions in varied enzyme systems while the role of vitamin B₁₂ may be more specific and confined only to certain enzymes of the mitochondria. It is tempting to speculate whether the effect of vitamin B₁₂ on the mobilisation of folic acid is in part at least attributable to a function for it in the conversion of folic acid to folinic acid. A recent report observes increased urinary folinic acid excretion in immature rats following administration of vitamin B₁₂ or whole liver powder.¹⁰

We may examine further the inter-relation between folic acid and vitamin B₁₂ with special reference to transmethyations. Of all biochemical functions attributed to the two vitamins, that relating to choline and methionine metabolism has perhaps been the most significant. An inter-dependence between these two methylating compounds on the one hand and folic acid and vitamin B₁₂ on the other has been observed in the nutrition of several species, mice, rats, dogs, chicks, etc.¹¹ also.^{1,3,4} More specifically it has been demonstrated that methionine,¹² creatine³ and nicotinamide (unpublished observations) metabolism are influenced by one or both of the vitamins. Choline oxidase activity is also related to vitamin B₁₂^{13,14} and to folic acid.¹⁵

For a proper attempt at interpreting these observations, one should take into account established facts concerning the biosynthesis of methyl groups which could occur in the tissues of the rat¹⁶ from the α carbon of glycine and the β carbon of serine as well as from formate and methanol^{17,18}; the ethanolamine moiety of choline could be derived from serine by decarboxylation.^{19,20} The reverse step, namely, the degradation of labile methyl to formate could also take place.¹⁴⁻²⁰ There are indications that the neogenesis of methyl groups is mediated by folic acid and vitamin B₁₂²¹⁻²³ but their exact significance in methyl economy has as yet remained obscure.

Since folic acid is concerned directly with formate production from glycine²⁴ and with its utilization for serine synthesis^{3,24} and possibly in other single carbon addition reactions such as nucleic acid formation,⁵ its sparing action on labile methyl requirement would seem explicable on the basis that the latter functions in transmethyations³ as well as in the transfer of glycine to serine and in other one carbon fragment fixation processes mediated by formate. In folic acid deficiency methyl drain to formate could occur excessively. Some proof of this possibility has been forthcoming from our observations on the impairment of normal creatine and nicotinamide metabolism in folic acid deficiency and on its partial restoration by administered methanol or formate (Table II).

The possibility is not excluded that folic acid in the above experiments might also act by accelerating methyl biogenesis from administered precursors. However, this latter argument is not in harmony with our later findings that in folic acid deficient mice there occurs no more synthesis of choline or methionine from exoge-

TABLE II

Effect of Formate or Methanol on Creatine and Nicotinamide Metabolism in Folic Acid deficient and Replete Mice

Group	Urinary creatine ³	Urinary N ¹ -methyl-nicotinamide * ²⁵
	(mg./100 g body wt./24 hrs.)	
Basal diet	1.57	71.0
Basal diet + formate	1.68	88.0
Basal diet + methanol	1.73	102.2
Basal diet + folic acid	1.80	119.0
Basal diet + folic acid + formate	1.86	117.6
Basal diet + folic acid + methanol	1.88	122.9

Adult mice, inbred Swiss strain, were used, not less than four to a group in each case. Basal diet was the folic acid-free purified ration² with 15 gamma per cent. of vitamin B₁₂. Folic acid was administered orally at 10 gamma/mouse/day while methanol or formate was given intraperitoneally at 1 mg./mouse/day.

*In addition to that present in the basal diet, the animals here received 1 mg./day each nicotinamide during the urine collection period of 48 hours following an equilibration period of 2 days.

Urine samples were collected on the 8th and 9th days following the grouping after the onset of folic acid deficiency on the basal diet as shown by a haemogram; this preparatory period was 5 weeks.

The fuller data and related observations will be published by P. Fatterpaker, U. Marfatia and A. Sreenivasan.

nously administered precursors, methanol and serine, as a result of folic acid supplementation than from metabolically derived precursors (Table III).

TABLE III

Probable non-involvement of Folic Acid in Methyl synthesis from Precursors

	Folic acid deficient		Folic acid replete	
	Choline	Methionine	Choline	Methionine
	(mg. per g. of liver)			
No precursors	5.08	5.44	6.05	5.77
Methanol + serine	5.40	5.60	6.42	6.00

Basal ration and administration of folic acid as in the previous series. Precursors (1 mg. methanol and 2 mg. of dl-serine) were given in solution intraperitoneally on the 8th day after grouping following overnight fasting; animals were killed 6 hours later following access to

feed for the last 5 hours. Choline was determined with a *Neurospora* (cholineless) *crassa* mutant²⁶ and methionine colorimetrically.²⁷ Details will be published by P. Fatterpaker, U. Marfatia and A. Sreenivasan.

It would seem therefore that folic acid is not directly concerned in methyl synthesis but that it contributes to methyl conservation and hence to increased transmethylation through inhibition of degradation to formate. On the other hand, it may be that vitamin B₁₂ promotes such synthesis from precursors²¹⁻²³ besides being implicated in choline to betaine¹⁴ and to methionine^{3,28} transformations, although methionine may be formed from precursors independently of choline.²⁹ The synergism between folic acid and vitamin B₁₂ in transmethylation would thus arise from a check by the former and an acceleration by the latter on the catabolic and anabolic aspects respectively of methyl metabolism.

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PROFESSOR K. N. BAHL

PROFESSOR K. N. BAHL has retired from the Chair of Zoology at the Lucknow University which he served with great distinction for nearly 30 years. It is very well known that under his inspiring guidance, Lucknow became the leading centre of zoological research in the country.

Professor Bahl's contributions to zoology fall into two categories. First may be mentioned his researches, especially on the morphology and physiology of the earthworms and other invertebrates. The elucidation of the structure, development and physiological function of the excretory system of earthworms may be regarded as his most important contribution. His tastes are, however, catholic and he has elucidated with great skill the details of pairing and egg-laying in the snail *Pila*, and the structure of the skull of the reptile *Varanus*.

And secondly, Prof. Bahl was the founder and editor of the now famous series, *Indian Zoolo-*

gical Memoirs on Indian animal types, of which 8 volumes have so far been published. The publication of these memoirs is a land-mark in the history of Indian zoology, as they provide the basis for graduate and post-graduate teaching of morphological zoology of the invertebrates in India.

Professor Bahl was President, Zoology Section of the Indian Science Congress (1924), Foundation Fellow and President, National Academy of Sciences, Allahabad (1933-35), and a Fellow of various other societies. He has also been closely associated with the Zoological Society of India since its inception in 1939, and is the Society's President, having been elected to that distinguished office in 1950. Since his retirement Professor Bahl has accepted the Vice-Chancellorship of the Patna University.

Our heartiest good wishes to him for a long and happy life dedicated to the advancement of science.

M. L. ROONWAL.

LETTERS TO THE EDITOR

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FLUORESCENCE TEST FOR THE O-HYDROXY-CARBONYL GROUP IN AROMATIC COMPOUNDS

NEELAKANTAM, et. al.¹⁻⁴ in a series of papers reported on the effect of adding a small amount of boric acid on the fluorescence, under u.v. light, of solutions of a large number and a wide variety of aromatic compounds containing the o-hydroxy-carbonyl group, dissolved in concentrated sulphuric acid. Reactions of limited utility were suggested for the detection of this group in hydroxy-acids by Jean-Renaud,⁵ Anschütz⁶ and Nölting⁷; in hydroxy-ketones by Pfeiffer⁸ and hydroxy-anthraquinones by Dimroth.⁹ Pyman's¹⁰ test with ferric chloride is most commonly employed for the detection of the above group in hydroxy-ketones.

It has now been found that the fluorescence test is also applicable to 1-acyl-2-naphthols, as verified with eight such compounds recently synthesised by Sen and Bhattacharji.¹¹ The acyl groups were propionyl, butyryl, isobutyryl, caproyl, lauryl, myristyl, octonoyl and decanoyl. The test was carried out by dissolving the compound in concentrated sulphuric acid and treating one half of the solution with boric acid. The two halves were placed in quartz test tubes and examined under an U.V. analytical lamp in a dark room. Without the boric acid, the compounds exhibited no fluorescence in day light and a pale yellow fluorescence under U.V. light. On the addition of boric acid, there was no fluorescence in day light but under the lamp an intense fluorescence was observed in all these cases. The effect was quite marked.

Grateful thanks are due to Drs. Sen and Bhat-
tacharji for providing the samples.

Chemical Laboratories, N. APPALA RAJU.
Andhra University, K. NEELAKANTAM.
Waltair,
October 18, 1951.

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$^5\Pi - ^5\Sigma$ ELECTRONIC TRANSITION IN COBALT CHLORIDE

THE band spectrum of the diatomic molecule CoCl has been obtained using a heavy current discharge from a 2 K.W. D.C. generator in a specially designed quartz tube with hollow cylindrical electrodes. The bands are red degraded and occur in six groups extending from λ 6000 to 5300 Å. One of the groups extending from λ 5770 to 5650 Å stands out prominently and is considered as $\Delta v = 0$ group. The bands are fine-like and are similar to the band systems obtained in MnCl ¹ and FeCl .² The bands are of complex structure and show an abnormal intensity distribution among the heads and are assigned to the transition $^5\Pi - ^5\Sigma$, involving quintet electronic states.

The wave numbers corresponding to the Q_5 , Q_4 , Q_3 , Q_2 and Q_1 heads obtained in the 0, 0 sequence are 17638.8, 17555.9, 17484.1, 17411.0 and 17328.0 cm^{-1} respectively. The vibrational constants obtained in the present investigation are $w'_0 = 412.3$ and $w'' = 416.0$.

Full details of the analysis will be published elsewhere.

Department of Physics, V. G. KRISHNAMURTY.
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PHYSICO-CHEMICAL INVESTIGATIONS OF SOME MYSORE CLAY SAMPLES

THE properties of clays depend to a large extent on their clay mineral composition. The base

exchange capacity and the differential thermal analysis of representative samples of Mysore clays were investigated in this laboratory with a view to classify the samples according to their clay mineral composition. The Mysore clays were collected from (i) Gullahalli, (ii) Bageshpur, (iii) Tirthahalli, (iv) Gollahalli, and (v) Hebbur, and kindly supplied by Dr. N. V. Raghunath of Government Porcelain Factory, Bangalore. The clay samples were passed through a 100 mesh sieve and dried over phosphorous pentoxide at room temperature.

The base exchange capacity of the clays, determined by the ammonium acetate method described by Kelly, *et al.*,¹ are given in Table I. The base exchange capacity is given as the number of milliequivalents of ammonia taken up by 100 g. of the clay sample. The base exchange capacity of standard clay minerals is also given in this Table.

TABLE I

Clay sample	Base Exchange capacity	Reported values for the base exchange capacity of standard minerals
i) Gullahalli	3.0	Kaolinite 3-15
ii) Bageshpur	7.4	Halloysite 6-20
iii) Tirthahalli	4.3	Illite 20-40
iv) Czechoslovakia	7.8	Montmorillonite 60-100
v) Gollahalli	18.1	
vi) Hebbur	20.8	

The results indicate that samples (i) to (iv) belong to kaolinite group, while sample (v) may be halloysite whose base exchange capacity varies from 6 to 20. The base exchange capacity of samples (vi) on the other hand, indicates that this clay may be an illite.

The differential thermal analysis was carried out by the method of Norton² employing chromel-allumel thermocouples and the results are given in Fig. 1. The curves for samples (i) to (iv) indicate an endothermic peak at 625° C. corresponding to the temperature at which kaolinites lose the water. An exothermic peak at about 980° C. is also exhibited by each one of these curves which corresponds to the transformation of amorphous alumina to γ alumina. These characteristic peaks indicate that all these samples are kaolinites.² Gollahalli sample, on the other hand, has an additional characteristic endothermic peak at about 150° C., which is due to the adsorbed water of the halloysite.² Thus in the case of samples (i) to (v) the results obtained by the thermal analysis confirm those obtained by the base exchange capacity.

In the case of Hebbur clay, the thermal curve indicates two endothermic peaks at 250° C. and 700° C. respectively in addition to the usual peaks of kaolinites. The former two peaks are characteristic of montmorillonite.²

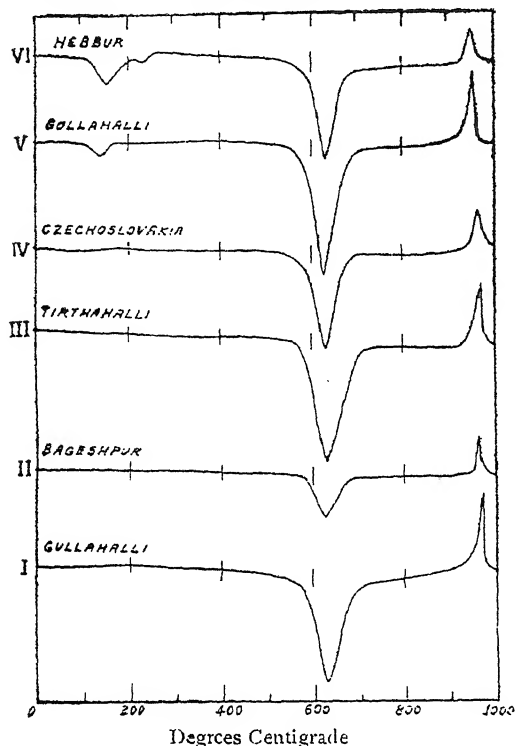


FIG. 1

It is thus clear that the Hebbur sample is not an illite as indicated by the base exchange capacity experiments. The high base exchange capacity of this sample must be due to the presence of small quantities of montmorillonite in the kaolinite sample.

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November 1, 1951.

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DEFLUORINATION OF PHOSPHATIC NODULES BY CHLORINE

THE removal of fluorine from rock-phosphate has attracted a good deal of attention during recent years, especially, in the United States of

America. Phosphorus in natural rock is only slightly available to growing plants. The availability of phosphorus in the sample is judged by its citrate solubility.¹ The presence of fluorapatite $[\text{Ca}_{10}\text{F}_2(\text{PO}_4)_6]$ is assumed to be largely responsible for the low citrate solubility of the rock phosphate.² Most of the methods of defluorination of the rock phosphate involve the heating of the mineral at very high temperatures often ranging from 1,480 to 1,645° C.³

Investigations on the chlorination of phosphatic nodules (F = 3%; P_2O_5 = 25%) from Trichinopoly area indicated that considerable quantities of fluorine could be removed from the nodules at comparatively low temperatures. Chlorine was passed over briquettes of phosphatic nodules (10 g.) containing about 15% carbon at various temperatures. In presence of carbon, chlorine reacts with the nodules giving silicon tetrafluoride and phosphorus oxychloride as volatile products. The oxychloride was condensed by cooling the mixture to 0° C. and the uncondensed silicon tetrafluoride was hydrolysed by passing through water. The fluorine content of the aqueous suspension was estimated by the method of Willard and Winter.⁴ After chlorination for 90 minutes, the residue was found to be practically free from fluorine. Representative results are given in Table I.

TABLE I
Defluorination of Phosphatic Nodules at Different Temperatures

Time in minutes	Percentage of fluorine found in the aqueous suspension		
	400° C.	500° C.	600° C.
15	4.3	10.9	3.3
30	38.1	53.6	13.6
45	57.5	88.5	50.6
60	72.9	93.2	81.3
75	86.5	94.8	89.9
90	93.9	95.0	95.2

In order to study the nature of the chemical action during defluorination, chlorine was allowed to react with precipitated calcium fluoride at 500° C. employing the following mixtures:—

(1) Calcium fluoride only, (2) Calcium fluoride + 15% carbon, (3) Calcium fluoride + 40% silica, and (4) Calcium fluoride + 15% carbon + 40% silica. The results are given in Table II.

TABLE II

Time in minutes	Percentage of fluorine in the aqueous suspension			
	CaF ₂ only	CaF ₂ + C (15%)	CaF ₂ + SiO ₂ (40%) ¹	CaF ₂ + C (15%) + SiO ₂ (40%)
30	..	..	..	50.1
90	1	8	1	58.4

When calcium fluoride was substituted by fluorapatite in the above chlorination experiments, the results given in Table III were obtained.

TABLE III

Time in mins.	Percentage of fluorine in the aqueous suspension		
	Fluorapatite only	Fluorapatite + C (15%)	Fluorapatite + C (15%) + SiO ₂ (3.5%)
15	..	15.5	22.1
30	..	27.6	40.4
50	..	34.9	62.7
90	19	38.8	96.1

Coronet Phosphate Co.,⁵ has reported that a good percentage of fluorapatite can be converted into chlorapatite by chlorinating the fluorapatite between 1090°C. and 1315°C. But the results of the present investigation indicate definitely that in presence of carbon and silica, defluorination of fluorapatite can successfully be carried out at as low a temperature as 500°C.

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SYNTHESIS OF 4-METHYLSCOPOLETIN AND SCOPOLETIN

THE oxidation of 4-methyl-7-coumarinyl-*p*-toluenesulphonate by alkaline potassium persulphate gave 4-methyl-6-hydroxy-7-coumarinyl-*p*-toluenesulphonate which on methylation and subsequent removal of the *p*-toluenesulphonyl

group gave 7-hydroxy-6-methoxy-4-methylcoumarin which was identical in respect of the m.p. and other chemical and physical properties with 4-methylscopoletin, synthesised by Baker and Evans¹ with the exception of the ferric chloride colour reaction. Whereas Baker and Evans' product gave a greenish colouration, our product gave the negative test. Our experience of this reaction with half-a-dozen coumarin derivatives containing the hydroxyl and methoxyl groups in the *ortho*-position supports this observation. Similarly, the oxidation with alkaline potassium persulphate of 7-coumarinyl-*p*-toluenesulphonate gave 6-hydroxy-7-coumarinyl-*p*-toluenesulphonate which after methylation and subsequent removal of the *p*-toluenesulphonyl group gave 7-hydroxy-6-methoxy-coumarin or *scopoletin*, synthesised by Head and Robertson² by the application of the Perkin's Reaction to 2:4-dihydroxy-5-methoxy-benzaldehyde.

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PRODUCTION OF ITACONIC ACID BY *ASPERGILLUS TERREUS*

It was discovered by Calam, Oxford and Raistrick¹ that certain strains of *Aspergillus terreus* can convert dextrose into itaconic acid. Later, Lockwood and Reeves,² Lockwood and Ward,³ Moyer and Coghill,⁴ and Lockwood and Nelson⁵ described experiments in which dextrose in nutrient media containing corn steep liquor was converted into itaconic acid in about 30% yield in surface or agitated cultures.

Experiments were conducted by the authors using two strains of *Aspergillus terreus*, viz., NRRL 255 and NRRL 1960, to study the optimum conditions for production of maximum yields of itaconic acid using dextrose (Dextrosol of Corn Products Company) and inorganic salts without the addition of any corn steep liquor. Preliminary experiments disclosed that only NRRL 1960 yielded appreciable quantities of itaconic acid and all further experiments were confined to this strain. Tables I, II, III and IV show the results obtained by varying the concentrations of one constituent at a time in a medium consisting of dextrose 15%, NH₄NO₃

0.2%, KH_2PO_4 0.1%, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ 0.05%, KCl 0.05%, and HNO_3 20 mls. N/2 per litre. The mould was always grown in 250 mls. erlenmeyer flasks holding 66.7 mls. of the medium. Incubation was carried out at 34°C . and the itaconic acid was estimated by the method of Friedkin.⁶ Yields were calculated on the dextrose consumed assuming that one mol. dextrose yields one mol. of itaconic acid. All values in the Tables are calculated for 100 mls. of original media.

TABLE I

(Concentration of NH_4NO_3 varied. Incubation Period 15 days)

	0.1% NH_4NO_3	0.2% NH_4NO_3	0.3% NH_4NO_3
Dextrose consumed (g.)	14.03	12.80	12.67
Itaconic acid (g.)	4.15	3.22	0.64
Yield (molar) %	40.9	34.8	7.0

TABLE II

(Concentration of KH_2PO_4 varied. Incubation Period 13 days)

	0.05% KH_2PO_4	0.1% KH_2PO_4	0.15% KH_2PO_4
Dextrose consumed (g.)	13.05	14.25	14.40
Itaconic acid (g.)	3.75	3.82	3.75
Yield (molar) %	40.0	37.1	36.1

TABLE III

(Concentration of MgSO_4 varied. Incubation Period 15 days)

	0.025% MgSO_4	0.05% MgSO_4	0.075% MgSO_4
Dextrose consumed (g.)	10.15	11.85	12.0
Itaconic acid (g.)	1.39	2.85	2.25
Yield (molar) %	19.0	33.3	26.0

TABLE IV

(Concentration of KCl varied. Incubation Period 15 days)

	KCl absent	0.025% KCl	0.05% KCl
Dextrose consumed (g.)	12.98	11.25	10.28
Itaconic acid (g.)	4.0	3.17	3.0
Yield (molar) %	42.7	38.9	40.3

KH_2PO_4 0.05%, MgSO_4 0.05% with or without traces of KCl . Further experiments are in progress with other substrates and the results will be published elsewhere.

The authors are grateful to Dr. S. H. Zaheer, Director of the Central Laboratories, for many helpful suggestions.

Cent. Labs. for Scientific K. RAMACHANDRAN.

and Industrial Research, Mrs. Z. H. OSMANI.

Hyderabad-Dn.,

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THREE NEW BACTERIAL DISEASES OF PLANTS FROM BOMBAY

A NEW bacterial leaf-spot of *Lawsonia alba* Lam., was noticed at Baroda in October, 1950. On the leaves, the pathogen produces few, small, round, water-soaked areas, measuring initially 1 to 2 mm., mostly at the periphery of the leaf. Some of them increase in size to 2-3 mm. and become dark brown to jet black. On the other hand, undeveloped spots remain as pale brown specks, the areas around such spots turn pale brown and brittle. Bacterial ooze in the form of small shining beads or fine scales is found on both sides of the spot which gets depressed on the undersurface of the leaves, the corresponding areas on the upper surface being raised and presenting a pale white appearance due to bacterial exudation. The pathogen infects leaves only. Since no bacterial disease has so far been reported on this host or related plants, it is proposed to assign the bacterium a new name *Xanthomonas lawsoniae* nov. sp. whose short description is given below:—

Short rods; single, rarely in chains of two; single polar flagellum; $0.7 \times 1.8 \mu$; Gram-negative; capsulated; no spores; on potato dextrose agar plates, the colonies are circular with entire margins, smooth, shining, convex with striations at the periphery only, measuring 1.8 cm. after 5 days; colour empire yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; hydrogen sulphide produced; ammonia produced from peptone; nitrite not produced from

It was concluded that the optimum concentrations of the salts would be NH_4NO_3 0.1%,

nitrate; M. R. and V. P. tests negative; acid but no gas in dextrose, maltose, sucrose and lactose; no growth in salicin; optimum temperature for growth 30° C.; thermal death point about 51° C.; pathogenic to *Lawsonia alba* only. Found at Kamati Bag, Baroda.

2. A new bacterial leaf-spot of tamarind (*Tamarindus indica* L.), whose pods form a well-known condiment in India, was found quite common on trees round about Poona in November, 1950. On the leaflets, the pathogen produces few, small, round, water-soaked spots, measuring initially 0.5 to 1 mm. In the beginning, the spots are pale brown with a small, yellow halo around them which later increase in size to 3-5 mm., become irregular and dark brown to jet black. Spots also develop along the line of the mid-vein. Deep black spots on petiole and rachis are rarely seen. Bacterial ooze in the form of small, shining beads or fine scales is found on both sides of the spot which is raised due to heavy bacterial exudation. Since no bacterial disease has so far been reported on this host, it is proposed to assign the causal organism a new name *Xanthomonas tamarandi* nov. sp. whose short description is given below:—

Short rods; single; single polar flagellum; 0.6 to 1.6 μ ; Gram-negative; capsulated; no spores; on potato dextrose agar plates, the colonies are circular with entire margins, smooth, shining, convex with striations at the periphery only, measuring 1.4 cm. after 5 days, colour martius yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; hydrogen sulphide produced; ammonia produced from peptone, nitrites not produced from nitrate; M. R. and V. P. tests negative; acid but no gas in dextrose, maltose, sucrose and lactose; no growth in salicin; optimum temperature for growth 30° C.; thermal death point about 51° C.; pathogenic to tamarind; distribution general.

3. A severe bacterial angular leaf-spot of *Euphorbia pulcherrima* Willd. (Poinsettia) was observed at Bombay in December, 1950. On the leaves, the pathogen produces few to numerous minute water-soaked spots visibly clear on the lower surface, measuring initially 0.5 mm., fairly well distributed all over the leaf surface. With the progress of the disease, the spots increase in size to 1.5 mm., become angular and brown with deep coloured periphery. Like other bacterial diseases, the ooze in the form of small shining beads is found on the underside of leaves. Tender stems are infected in the form of irregular vertical gray streaks which

soon engirdle the stem. In this respect, the disease resembles the one described by Starr and Pirone (1942).¹ But the causal organism under study differs from *Corynebacterium poinsettiae* Starr and Pirone as it is Gram-negative and yellow; hence it is proposed to assign it a specific name *Xanthomonas poinsetticola* nov. sp. whose short description is given below:—

Short rods; single or in chains of two or three; single polar flagellum; 0.6 \times 1.3 μ ; Gram-negative; capsulated; no spores; on potato dextrose agar plates, the colonies are circular with entire margins, smooth, shining, convex with striations at the periphery only; measuring 2 cm. in diameter after 5 days; colour picric yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; hydrogen sulphide produced; ammonia produced from peptone; nitrites not produced from nitrate; M. R. and V. P. tests negative; acid but no gas from dextrose, maltose, sucrose, and lactose; no growth in salicin; optimum temperature for growth 30° C.; thermal death point about 51° C.; pathogenic on *E. pulcherrima* only, found in Hanging Gardens, Bombay.

Fuller details will be published elsewhere.

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August 9, 1951.

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POLYPLOIDY IN A SHORT-HORNED GRASSHOPPER

Mickey¹ reported polyploid spermatogonial cells in a North American genus, *Romalea microp-tera* (Beauv.) and also studied the meiotic mechanism in them. The present author also obtained a sporadic case of tetraploidy in the spermatogonial stage in an Indian Acridid, *Oedaleus abruptus* Thunb., obtained from Izatnagar, Uttar Pradesh, and the finding is reported herein.

Out of many specimens examined, only one individual showed polyploidy in one of its testicular follicles. The closed tip of this particular follicle had two distinct cysts on either side—both being tetraploid ones. The two X-chromosomes in these tetraploid nuclei were found to be negatively heteropycnotic. The number of chromosomes in only two nuclei could be counted accurately (Fig. 1); while in the remaining ones it was not possible as they were

on the side. The chromosome number in these nuclei was found to be $4n = 44$, two less than what is expected. The missing ones were perhaps overlapped by some other chromosome which could not be detected or they were

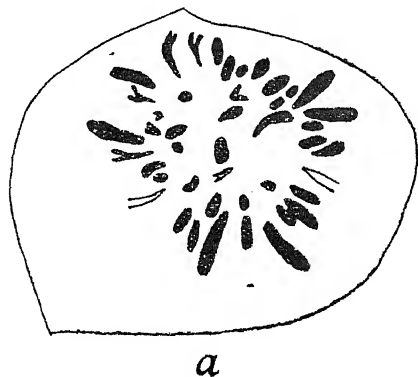


FIG. 1. Spermatogonial metaphase in *Oedotus* showing $4n = 44$ Chromosomes, $\times 1760$.

lost during sectioning. Tetraploid metaphase stage may originate due to complete separation of chromatids during prophase with omission of one metaphase,² by fusion of daughter nuclei following anaphase separation and the failure of cytokinesis,³ or by fusion of two prophase nuclei in a binucleate cell when the nuclear membrane is dissolved prior to metaphase.⁴ Koller⁵ described tetraploid spermatogonia in *Hexacentrus mundus*, a long-horned grasshopper; but due to the absence of syndiploidy in that genus he believed that those originated through failure of the daughter chromosomes to segregate towards the opposite poles at mitotic anaphase. Since the number of polyploid cells, obtained in the present case, was very few which, moreover, were localised in only one of the follicles, it was not possible to conclude by what particular method they had taken their origin. Further observations based on smears may give valuable information on this point.

My thanks are due to Dr. P. Bhattacharya, Indian Veterinary Research Institute, for giving me necessary facilities and for helpful criticism.

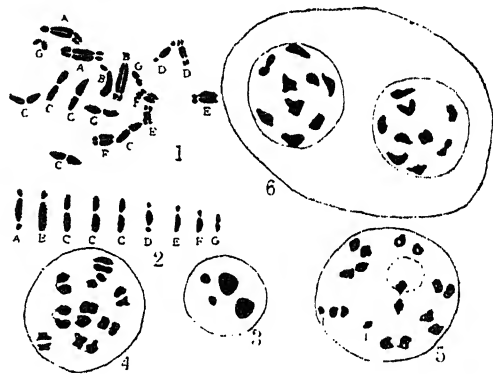
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CYTOLOGY OF *LIMNANTHEMUM CRISTATUM* GRISEB.

THOUGH many important genera of the family Gentianaceae have been worked out till now^{1,2,5} several of the Indian members still remain unexplored. *Limnanthemum cristatum* Griseb. is one of the most widely distributed species of the family growing abundantly in ponds, both mitotic and meiotic studies of which have been made here.

For the study of the mitotic chromosomes, root tips were fixed in different fixatives of which Oxyquinoline fixation (Sharma and Ghosh, 1950), proved to be the most suitable one. Tjio and Levan's method (1950), for temporary preparations has also yielded very good results (Fig. 1). The materials fixed for preparing permanent blocks were dehydrated and infiltrated as usual and paraffin sections 15μ thick were cut. For the study of the meiotic stages flower buds were smeared in Nawaschin's fluid.



FIGS. 1-6. ($\times 1,800$)

FIGS. 1 and 2—Somatic Metaphase plate showing 18 chromosomes (fixed in Oxyquinoline) and Idiogram of the same respectively.

Fig. 3—Telophase nucleus showing 4 nucleoli.

Figs. 4 and 5—Diakinesis showing 9 bivalents, and 8 bivalents and 2 univalents respectively.

Fig. 6—Second Division nuclei showing 9 chromosomes in each.

The somatic chromosome number of the species has been found to be 18. The chromosomes could be classified mainly on the basis of their primary and secondary constrictions. Size difference has not been found to be very marked, ranging between 1.5μ to 3.7μ . The details of the morphology are illustrated in Fig. 2.

Corresponding to 4 SAT-chromosomes, 4 nucleoli forming two homomorphic pairs were observed in the telophase stage of root tip nuclei (Fig. 3).

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During the meiotic stages, 9 bivalents were distinctly noticed in the pollen mother cells. Diplotene presents an interesting peculiarity in the complete terminalisation of the chiasmata. Moreover, it is also worthy of note that chromatid separation is apparent at this stage (Fig. 4). Occasional pollen mother cells were observed with 8 bivalents and 2 univalents in diakinesis (Fig. 5).

Clear 9 bivalents were noticed in the metaphase and distinct 9 and 9 segregation in two poles resulting into clear 9 chromosomes in each of the second division nuclei were also observed (Fig. 6).

Pollen sterility has been found to be negligible.

The absence of any multivalent formation or of secondary association of bivalents and, moreover, the absence of any significant meiotic irregularity show that the species under investigation is, in all probability, a true diploid.

Lastly, I wish to express my sincere gratitude to Mr. A. K. Sharma, Calcutta University, for helpful guidance, and to Prof. P. C. Sarbadhikari, for facilities offered during this investigation.

Cytogenetics Lab.,

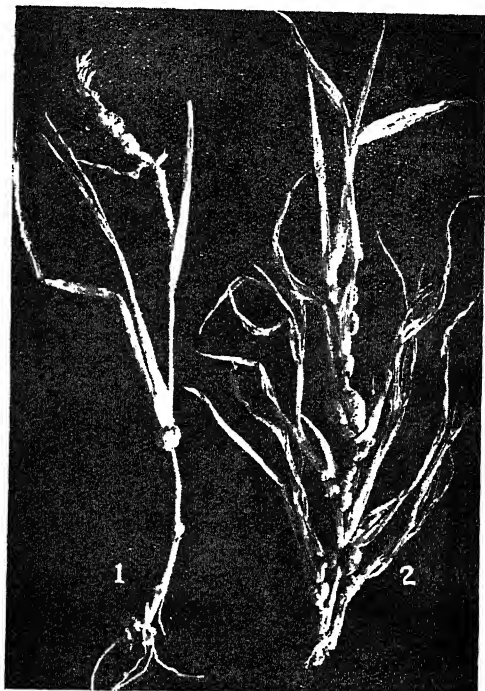
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SMUT ON *ECHINOCHLOA COLONA* LINK.

*Echinochloa colona** is a good fodder grass found commonly on the banks of rivers, on bunds in paddy fields, and in marshy localities of the Mysore and Mandya Districts of Mysore State. During the course of a survey made in October, 1949, a smut producing galls on the grass was noticed. The galls occur on the stems and nodes, and sometimes on the rachis of the inflorescence (see Fig. 1). In many cases the inflorescence fails to appear. Where it does appear, the rachis is hypertrophied, and a few

spikelets are seen. The parts of the spikelets themselves are unaffected. The leaves are free of the infection. The galls are irregular or elongated, and vary in length from 2 to 12 mm. and in thickness from 2 to 4 mm. (see Fig. 2). They occur crowded together so that the smut sori have the appearance of brain-like folds.



The sori are composed of the host tissue, and contain a mass of loose sooty powder, the spores of the fungus. The spores are liberated by the rupture of the gall membrane. The spores are roundish or ellipsoidal, brown, thinly echinulate, measuring $7.6-11.4\mu$ in greatest diameter. They germinate in tap water in 18-24 hours producing a septate promycelium. The sporidia are terminal or lateral. The fungus has been identified as *Ustilago crus-galli* Tracy and Earle.

Tracy and Earle reported this fungus on *Echinochloa* (*Panicum*) *crus-galli*, the Barnyard grass in U.S.A. It has been found also in Australia on the same grass. Mundkur¹ has noticed *U. crus-galli* on *E. frumentacea*. This host plant has been variously considered to be a variety of *E. (Panicum) crus-galli*, and *E. (Panicum) colona*, but has, since 1936, been accorded an independent status. According to Mundkur¹ the smut *U. panici-frumentacei sensu* Butler on *E. frumentacea* (*Panicum frumentaceum*), but not *U. panici-frumentacei* Brefeld is *U. crus-galli*. There is no record of this

* We are indebted to Fr. H. Santapau, S.J., t. Xavier's College, Bombay, and Sri. C. Rajasekhara Mudaliar, Government Lecturing and Systematic Botanist, Agricultural College and Research Institute Coimbatore, for independently identifying the specimens' of this grass.

fungus on any other grass or cereal in India. It is strange that if *E. frumentacea*, is a variety of *E. crus-galli* or *E. colona* any of these grasses has escaped infection by the smut. It could not have gone unnoticed because of the marked deformities it causes on the plant. This present record brings out the affinities of the fungus and the host plants it infects.

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MULTIPLE BUDS IN SUGARCANE

WHILE one bud is the usual condition in sugarcane, the occurrence of buds more than one was noticed in a few hybrid seedlings. These multiple buds 2 to 4 in number are juxtaposed along the root band almost touching one another. All the buds at a node are of similar size and form. However, not all the nodes in a seedling showed this condition. A few had single buds, some had two buds, and a majority three buds and very few, four buds. The occurrence of multiple buds could be of practical importance especially in sugarcane provided they are viable and give rise to as many daughter culms as there are buds in each node.

The occurrence of multiple buds has been noticed in the following varieties.

- (1) Co. 781—(P. 3247 × Co. 440).
- (2) P. 7281—(Co. 603 × Co. 449).
- (3) P. 335/1—M. 2811 (Vellai × Narenga × [*S. spontaneum* Glagh × *E. Munja* Spiny) selfed].

Neither of the parental forms in each cross showed this character and if this character expresses itself in the hybrid, the indication is that it is a case of two non-allelic genes acting together to produce a phenotype (so far as this character is concerned) different from that produced by either alone. This is on the assumption that the character in question is genic. If so, this feature must be exhibited by the clonal progeny resulting from these culms.

To test this, setts having one, two, three and four buds from each seedling were planted separately in pots having the ordinary soil mixture of tank silt, sand and farmyard manure. In every case only one bud germinated to form shoots. These were allowed to grow up to maturity and the canes were examined for the presence of multiple buds. There were no more than a single bud at each node. Also the shoots

that came out of setts having one, two, three and four buds, were all identical. None of them possessed multiple buds. These were again planted and taken through the next generation. These also showed no trace of this character.

The occurrence of multiple buds is obviously not a genetically inherited character. Presumably it is due to some physiological cause, involving hormones or effect of minor elements on the varieties concerned.

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Coimbatore,
September 26, 1951.

CONTROL OF TERMITES IN SUGARCANE

GUPTA¹ has made certain recommendations towards the control of termites during the period of germination in hot weather. The author has also made attempts to control their attack by the use of tar emulsion, crude oil emulsion and tar emulsion with 'gammexane', the treatments being given with irrigation water. Some measure of success was achieved particularly with the last mentioned treatment, but the effect was only temporary and the treatment had to be repeated with each irrigation till the plant got established.

With a view to obtaining effective permanent control over termite attack, an experiment was conducted using two varieties, viz., Co. 419 and Co. 453. The following treatments were given to the setts prior to planting: (1) plugging the cut ends with coal tar, (2) treating the setts for 24 hours in a 2.5% solution of 'gammexane' P. 520, (3) treating the setts for 24 hours in a 5% solution of 'gammexane' P. 520, (4) treating the setts for 24 hours in a 2.5% solution of DDT Geigy's Guesarol 550, (5) treating the setts for 24 hours in a 5% solution of DDT Geigy's Guesarol 550, (6) treating the setts for 24 hours in a 4% solution of the disinfectant 'IZAL'. In addition to these, in a separate experiment the furrows were treated with 5% gammexane dust D. 025 at the rate of 20 lb. per acre at the time of planting (without the other treatments).

Maximum germination was recorded in the treatments with 'gammexane', those with DDT coming next in order. Germination was considerably affected in the treatment with 'IZAL' solution.

The termite attack was maximum in the 'control' and in the treatment with plugged cut ends. The mode of entry was, however, different in the two. In the former the entry was through

the cut ends while in the latter it was entirely through the buds. This is evidently due to the cut ends being repulsive owing to the presence of coal tar, so that the termites had to seek the next best soft portion, viz., the bud. The attack was fairly high in the treatment with 'IZAL'. The treatments with DDT also showed a fair amount of attack which was least in the treatments with 'gammexane'. Out of the three treatments with gammexane the dipping of the setts in 5% gammexane was superior to the others in the matter of less of attack of the termites.

Of the two commercially popular insecticides, DDT and gammexane, the latter seems to be better for the control of termites, as also from the point of view of germination, as it was found that it does not affect the latter.

My thanks are due to Shri. N. L. Dutt, Director, Sugarcane Breeding Institute, for kind guidance.

Sugarcane Breeding Inst., G. NARASIMHA RAO.
Coimbatore,
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A NOTE ON THE CHEMICAL COMPOSITION OF THE PENAEID PRAWNS OF MADRAS

THE nutritive values of prawns from Bombay (*Metapenaeus* sp., *Parapenaeus* sp., and *Acetes* sp.) have been estimated by Appanna and Devadatta¹ and of those from Calicut coast (*Penaeus monodon*, *Penaeopsis dobsoni*, *Penaeus semisulcatus* and *Trachypenaeus asper*) by Chari.² The results obtained by these authors show that the chemical composition of the body varies in the different prawns studied. Moreover, the above authors did not take into consideration factors like sex, size and seasonal changes. So an estimation of the chemical composition of four edible prawns available in Madras, viz., *Penaeus indicus*, *Penaeus carinatus*, *Metapenaeus monoceros* and *Metapenaeus dobsoni*, was attempted by the present author.

The chemical composition of both males and females of the four different species has been determined and tabulated. Each value presented in the table is the average of determinations of materials found in two lots of five prawns each. All the prawns chosen for analysis were of 11 to 14 cm. length and were collected from the sea during the months of June and July.

TABLE

Species	Sex	Water Per cent.	Fat Per cent.	"Solids" Per cent.	Per cent. Limit of error
<i>Penaeus indicus</i>	M	76.18	1.04	22.25	0.53
	F	76.38	0.95	21.86	0.81
<i>Penaeus carinatus</i>	M	73.26	1.08	25.09	0.57
	F	72.67	1.15	25.51	0.67
<i>Metapenaeus monoceros</i>	M	77.86	0.91	20.75	0.48
	F	75.07	0.90	23.17	0.86
<i>Metapenaeus dobsoni</i>	M	76.48	0.95	22.05	0.52
	F	77.54	0.89	20.82	0.75

It will be noted from the Table that in these four species of prawns differences due to sex are irregular and not marked. Estimations of the fat contents as well as the chemical composition of the body during the different seasons in prawns of different sizes are of value. Such a detailed study on *Penaeus indicus* has been made and will be treated in a separate account elsewhere.

The author's thanks are due to Dr. C. P. Gnanamuthu for his kind interest and guidance, and to Dr. G. Krishnan for his helpful suggestions.

Zoological Res. Lab., V. GOPALAKRISHNAN.
University of Madras,
Madras 5,
September 28, 1951.

1. Appanna and Devadatta, *Curr. Sci.*, 1942, **11**, 333.
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FORKING OF FILAMENTS IN *PENNISETUM TYPHOIDES* STAPF. AND HUBBARD

THE spikelets of *Pennisetum typhoides* Stapf. & Hubbard are characterised by two kinds of flowers, the upper flower perfect and the lower normally staminate (at times infertile, absent or rarely perfect). The stamens are three in number in both the upper and lower flowers.¹ An examination of the spikelets of number of types was made; in one particular plant belonging to a bulk selection M.S. 5640 (Local Sajja, Adoni, Bellary District, Madras State) instead of the normal three stamens, a greater number was observed in each flower. To know more about the extra number

of stamens nearly two hundred spikelets were examined. In all the spikelets, it was found that the lower flower was absent and the upper flower had four stamens as a general rule. Two of the flowers had five stamens.

The origin of the extra stamen were studied. In all except one flower four distinct filaments were observed (Fig. 1).

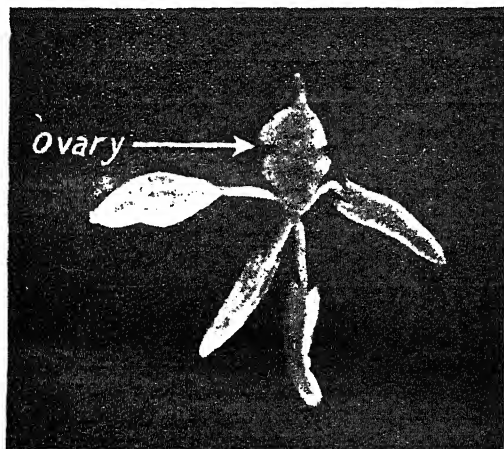


FIG. 1

In one particular flower, only three filaments were seen. One of these filaments had two distinct anthers, the filament having two branches at the distal end (Fig. 2).

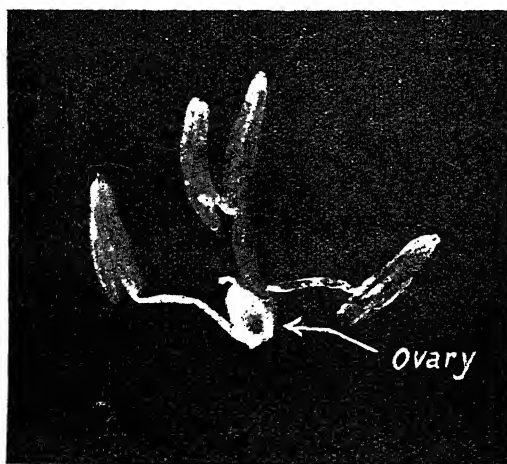


FIG. 2

This observation gave the clue that the extra stamen which is found to occur should have arisen by the forking of one of the filaments, the general pattern of the flower being trimerous.

Forking of awns and leaf-blades in *Sorghum* has been reported.² Concurrent forking of awn

and stigma has also been recorded³ in the same crop. As far as the authors are aware this is the first record of forking of filaments in the Gramineæ.

The character is probably mutational in origin and the inheritance of it is under study.

Agric. Res. Stn.,

B. W. X. PONNAIYA.

Koilpaṭṭi,

R. APPATHURAI.

October 5, 1951.

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CHROMOSOME NUMBER OF *GYMNOPETALUM COCHINCHINENSIS* KURZ.

THE material for the study of meiotic chromosomes was obtained from male flowers of *Gymnopetalum cochinchinensis* Kurz., a wild monœcious species of Cucurbitaceæ. Anthers were fixed in acetic-alcohol (1:2) between 1-30 p.m. to 1-45 p.m. Pollen mother-cells and pollen grains were studied in acetocarmine smears.

Diakinesis was the only stage of prophase which was studied. Eleven bivalents were counted in a large number of diakinetic nuclei (Fig. 1). The maximum number of bivalents found

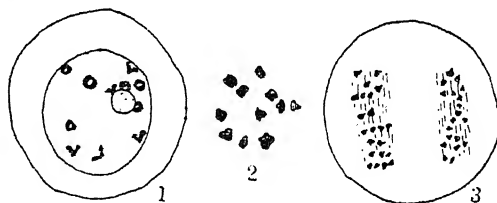


FIG. 1. Diakinesis, showing eleven groups of bivalents; note three bivalents attached to the nucleolus. FIG. 2. Metaphase I showing eleven bivalents. FIG. 3. Anaphase II showing lagging chromosomes. $\times 1000$.

attached to the nucleolus was determined to be three. Whether this indicates that this species is a secondary polyploid or a structural hybrid calls for further critical examination of this plant.¹ In polar view metaphase I, eleven bivalents were observed (Fig. 2), so that eleven is the haploid number of chromosomes in this species.

During anaphase II, laggards were observed (Fig. 3) in a small percentage of pollen mother-cells. Microspores which result from divisions of such pollen mother-cells are usually deficient in some chromosomes and this is probably the reason for the abortion of approximately 20 per cent. of the pollen grains of this species. Occur-

rence of such laggards in anaphase II has been recently reported by Rao² in *Sterculia colorata*.

Tetrad formation was found to be of simultaneous type.

A brief survey of the chromosome numbers of the members of Cucurbitaceae, so far studied shows that eleven is the haploid number of chromosomes in a number of genera which include *Citrillus*, *Lagenaria*, *Momordica*, *Trichosanthes*.³ Further study will alone reveal whether any of these genera bears any relationship with *G. cochinchinensis* where also the haploid number of chromosome has been determined to be eleven.

Dept. of Botany, AHMAD SHAMSUL ISLAM.
University of Dacca, B. SAHA.
October 7, 1951.

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A PRELIMINARY ACCOUNT OF CYTOLOGY OF THE HOUSE FLY *MUSCA NEBULO* F.

THE attention given to the house fly, in comparison with other species of the Diptera, which have long been a favourite group for cytological studies, is very meagre. Upto now only *Musca domestica* L. has been studied cytologically and a diploid number of 12 chromosomes with "XY" type of sex mechanism and spermatogenesis has been reported (Perje, A. M., 1948*).

During the course of cytological investigation in an in-bred race of the house fly, *Musca nebulo* F., which is common in India, about 25 males examined hitherto showed 6 chromosomes only in the somatic cells (Fig. 1), whereas



FIGS. 1 and 2. Somatic complement of male and female house fly, *Musca nebulo* F. with 6 and 12 chromosomes respectively. $\times 2500$.

all the females showed 12 chromosomes (Fig. 2). A comparative chromosome study revealed that the 12 chromosomes found in the female formed 6 homologous pairs while the 6 chromosomes in the male were without homologues. From

the above data it is inferred, that the male flies under investigation show haploidy, which is probably the result of parthenogenesis, as in the bees and wasps.

Further work is in progress.

Our grateful thanks are due to Dr. P. J. Deoras for guidance and to Dr. S. P. Agharkar for his kind interest and encouragement.

M.A.C.S. Laboratory, S. VISHVESHWARAIYA.
Law College Buildings, D. R. RANADE.
Poona 4,
October 12, 1951.

* Ann Margret Perje, "Spermatogenesis in *Musca domestica* L." *Hereditas*, 1948, **34**.

BIONOMICS OF *PHLEBOTOMUS* *ARGENTIPES* (ANN AND BRUN)

IN the course of a study of the bionomics of the sandfly, *Phlebotomus argentipes* (Ann & Brun), the following observations were made:—

(1) Wild sandflies (*P. argentipes*), caught fed in nature, were placed in a chimney with raisins for 48 hours or longer. After they had oviposited, second feeds on man were obtained.

(2) *P. argentipes* was also found to take a meal of blood from chickens. It was noted that *P. papatasi* (Scop.) also would feed on chicken's blood. Both *P. argentipes* and *P. papatasi* laid viable ova after a blood meal on chickens.

It may be pointed out that the Kala-azar Commission when working in Assam, failed to obtain second feeds with sandflies caught fed in nature. Since sandflies have been shown to feed on chicken's blood, it will be interesting to find out the effect of chicken's blood on the development of flagellates of *Leishmania donovani* in the gut of the sandfly. Epidemiological studies on Kala-azar have revealed an association between poultry keeping and the prevalence of *P. argentipes* in Kala-azar houses.

Our thanks are due to Prof. K. V. Krishnan, Professor of Microbiology, for facilities to take the course in his department and for permission to publish this note.

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All India Institute of R. RAMANI.

Hygiene & Public Health,
Calcutta,

October 16, 1951.

**THE FIRST RECORD OF THE GENUS
BRANCHINELLA SAYCE, IN INDIA AND
A NEW VARIETY OF *BRANCHINELLA*
KUGENUMAENSIS (ISHIKAWA)**

IN the course of my studies on the Anostraca of South India,^{1,2,3} I received a collection of preserved anostracans from Madura, which have now been identified as resembling the Japanese form *Branchinella Kugenumaensis* (Ishikawa⁴) with certain differences.

The males are characterised by the biarticulate second antenna, with the basal joint carrying numerous tubercles on the inner margin, and 9 long digitiform processes on the outer margin (Fig. 1 b). The apical joint is falciform and

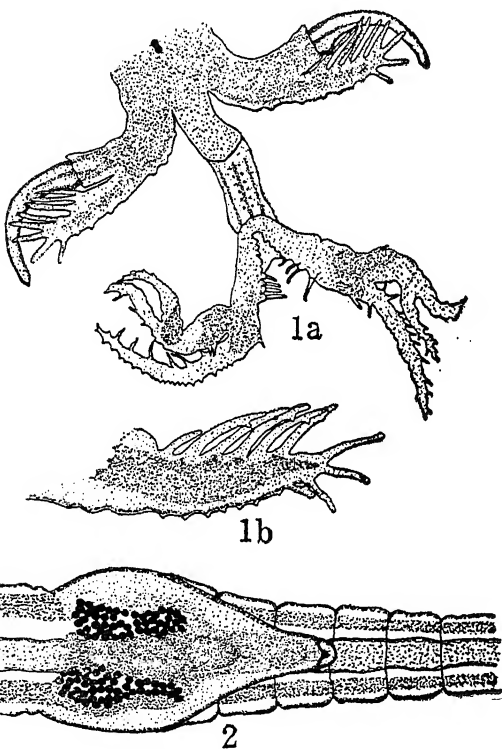


FIG. 1a. Frontal appendage and second antenna $\times 7\frac{1}{2}$ (Camera lucida)

FIG. 1b. Part of the basal joint, showing the digitiform processes $\times 33$ (Camera lucida)

FIG. 2. Ovisac $\times 8$. (Camera lucida)

movable. The frontal appendage of male is three-jointed. The basal joint is cylindrical, the middle with two rows of ventral spines is bifurcated at its tip into two rami. Each ramus is again triramous. The interior ramus is ensiform, with spines on either sides, and the two outer rami carry tubercles with minute spines (Fig. 1 a).

The females are characterised by the conelike small second antenna, with setose margin, and the apical end is acutely prolonged. The ovisac is short, oviform and extends to the end of the 4th abdominal segment (Fig. 2). The length of the body is 23 mm., thorax 10 mm., abdomen 9 mm. and caudal furca 4 mm.

These specimens were collected in August, from temporary puddles created by rain water, in and around Madura (S. India). A large number were available for detailed examination and they differ from Ishikawa's type specimen of Japan, with regard to the number of digitiform processes on the basal joint of the second antenna of the male, the shape and length of the ovisac, the size and shape of the flabella of the phyllopodia, and the spines on the frontal appendage.

Hence they can be conveniently treated as a distinct and a new variety of *Branchinella Kugenumaensis* (Ishik.) and can be designated as the var. *Madurai*.

A detailed account of the morphology and bionomics of this new variety will be published elsewhere.

My thanks are due to Dr. Joshua for providing facilities for working, and to Mr. K. J. Joseph and Mr. G. J. Phanuel, for supplying the material.

This first record of the genus *Branchinella* Sayce. in India, extends the range of the distribution of the genus to the oriental region also.

Dept. of Zoology, P. J. SANJEEVA RAJ.
Madras Christian College,
Tambaram,
October 11, 1951.

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**SOME SIGNIFICANT RECORDS OF
FISH FROM KOLHAPUR, NORTHERN
SECTION¹ OF WESTERN GHATS**

Among the collection of fish made by Shri A. G. Kalawar, Superintendent of Fisheries, Kolhapur, the writer has found some interesting species which are of great zoo-geographical significance. One of them is a Homalopterid fish which belongs to the genus *Balitora* Gray.² It agrees more or less with the form described from Mysore, *B. brucei mysorensis* Hora.³ This is the

first record of any Homalopterid fish from the northern division of the Western Ghats.⁴ Another new record is *Botia striata* Rao,⁵ a beautifully striped loach, which was described from Mysore, but has not so far been found from any other part of the Western Ghats.

The third interesting find is a catfish of the family Schilbeidae, collected by the author, for which a new genus and new species have been established. The account is under publication in the *Records of the Indian Museum*. The nearest ally of this fish is *Pseudeutropius acutirostris* Day⁶ from Burma. The occurrence of this new Schilbeid fish at Kolhapur emphasises further the great affinities of the fish fauna of the Western Ghats to the so-called Malayan fauna.⁷

The presence of these three fishes in the northern section of the Western Ghats supports Hora's Satpura Hypothesis⁸ of the route of migration of the Malayan element in the fauna and flora of Peninsular India. A detailed systematic treatment of these along with other fishes collected from Kolhapur will be published elsewhere.

I am grateful to Dr. S. L. Hora, for his help in the identification of *Botia striata* Rao and to Dr. S. B. Setna, for affording the necessary facilities.

Taraporevala Marine Biological Station,
Bombay,
November 2, 1951.

C. V. KULKARNI.

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THE PRESENCE OF *OPERCULINA GRANULOSA* (LEYMERIE)—FORAMINIFERA IN THE COASTAL WATERS OF TRAVANCORE

HOFKER¹ observes that *Operculina granulosa* shows a very high degree of variability, which in most cases seems to be due to trimorphism and in others, to outward circumstances, namely,

the quantity of chalk and the depth of water in which it is found. Dakin² mentions the presence of *O. granulosa* in the Gulf of Manaar, but no other details regarding its form and the seasonal abundance are available.

During recent investigations of the Bottom Fauna and Bottom Deposits of the Travancore Coast, many specimens of three different forms of this species have been collected. The largest specimen obtained is 6×4.4 mm. It possesses 41 chambers and resembles the type-specimen illustrated by Cushman³ (Fig. 6a, Pl. XV). The spiral is very irregular in some specimens and the beads are visible only in the central spiral. This form is rather rare on this coast and has been recorded only from Trivandrum at a depth of 12-15 fathoms.

There is another form which resembles (Fig. 5, Pl. XV), of Cushman,³ the largest specimen measuring 3.7×3.5 mm. and is more or less circular and possesses 34 chambers. Beads are present in all the whorls, except in the outer half of the peripheral whorl. It is found at Trivandrum and Vizhingom Coasts up to 15 fathoms.

Besides these two, there is another form which measures 4.3×3.3 mm., and in which the outer whorl is enormously enlarged. It resembles Fig. 2a, Pl. XVI, Cushman³ and bears beads on the first two whorls. This form is only rarely obtained on this coast and the limited number of specimens collected was from Trivandrum, 12-15 fathoms.

Among the numerous species of foraminifera collected from the Travancore Coast this is the only large-sized species and it is abundant in the deeper waters of Trivandrum, between 14-16 fathoms and it constitutes even up to 1.2% of the total dry weight of the bottom deposit in the March collections. At times, the tubes of certain polychaetes collected from this region are formed exclusively by the agglutination of the dead tests of this species.

Fisheries Research Station,
Kayamkulam,
November 7, 1951.

C. V. KURIAN.

1. Hofker, J., *Sibog. Exped. Monogr.*, 1927, 4, 1-78.
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REVIEWS

The Manufacture of Iron and Steel. Vol. 2.
By G. Reginald Bashforth. (Chapman & Hall),
1951. Pp. viii + 461. Price 45 sh. net.

The second volume on "The Manufacture of Iron and Steel", by G. Reginald Bashforth, keeps up the excellent standard set by the first volume. The text has been neatly divided into two basic parts, i.e., iron production and steel production and deals at length with the basic theory underlying various processes which constitute the modern metallurgy of iron and steel. Details of plant and machinery illustrate the text profusely and these are notable for the reference to their actual installation. The most notable feature of the text is the latest references to the work of numerous research workers published in various leading technical journals.

To the students of modern production metallurgy it should be an exceedingly useful publication. Although there are a number of textbooks in this field, none deals with the subject so comprehensively and effectively as the publication under review. To the production metallurgist it should readily present valuable reference data on various aspects of ferrous metallurgy.

The publication will admirably serve the purpose for which it is intended.

B. R. NIJHAWAN.

The Surface Chemistry of Solids. By S. J. Gregg,
(Chapman & Hall Ltd., London), 1951. Pp
297 + ix. Price 30 sh.

The surface properties of solids have evoked considerable interest in recent years, especially in view of their important bearing on many practical and industrial problems. The book under review provides an excellent survey of the important aspects of recently published research on this subject.

It is happy to note that the scope of this survey is not limited to the chemistry of solid surfaces, for it covers important physical and mechanical properties as well. The chapters dealing with active solids, adsorption, friction and lubrication, chromatography and the wetting of solids by liquids have received very lucid treatment. A short chapter on the application of the electron microscope and electron diffraction has been well placed in this work.

Coming to purely chemical properties, the chapters dealing with catalysis and chemisorption deserve to be amplified. Though the author has candidly excused himself in the Preface for the choice of the subject-matter, "inevitably reflecting the particular interests and prejudices of the author", one cannot help noticing with surprise the total exclusion of the important contributions of Volkenstein in Russia and the rather thin treatment of the theory of activated adsorption. It would also have been desirable to include chapters dealing with the measurements of magnetic susceptibility and semiconductivity of active solids.

There are very few typographical or other errors in the text. On page 18, ΔH refers obviously to the differential heat of adsorption per gram mole (not per gram) of the adsorbate. On page 120, lines 9 and 28, read Fig. 50 for Fig. 52.

The survey has been presented in a swift and lucid style, which makes it sufficiently intelligible to the more advanced undergraduate student. To the researcher, it provides a key to the vast complexity of literature on the physics and chemistry of surfaces. The printing and get-up of the book are both commendable.

M. V. C. S.

Chemistry and Biology of Proteins. By Felix Haurowitz. (Academic Press Inc., New York), 1950. Pp. xii + 374. Price \$5.50.

The circumstance that proteins constitute the fundamental substrate of living matter, has lent to the subject an unchallenged position of importance which is shared by few other topics. The exceptional significance of proteins in biological chemistry is realised if attention is called to the fact that some of the vital components of life, enzymes, hormones, antigens, antibodies and viruses fall into the domain of proteins.

The absence of a suitable text-book on this subject giving a "uniform outline of the present state of the protein problem" for the benefit of students of chemistry and of biological sciences, has long been felt and the distinguished author, by presenting this excellent volume under review, has earned the gratitude and admiration of his readers.

In writing the text, the author has kept in mind the requirements of those interested in the fundamental aspects of the subject. The main topics which are discussed in a series of 17 brilliant chapters, include (1) protein structure, (2) biological activity of proteins, and (3) their biosynthesis in the living cell.

An admirable feature of the volume is the way in which the author has harmonised the old and the new concepts of the nature of the protein molecule and its varied reactions and manifold functions. For brevity of style and clarity of expression, there are few texts which can equal this treatise, which represents an inspiring model for others to follow. We have no doubt that this volume will command a large audience.

Parasites of Domestic Animals. By T. W. M. Cameron. 2nd Edn. (Published by Adam & Charles Black, London), 1951. Price 38 *sh.*

This is a completely revised edition of Professor Cameron's earlier text-book "The Internal Parasites of Domestic Animals, 1934", enlarged, to include the external parasites also, which has necessitated the change in the title. The arrangement of the subject-matter is quite original and is a result of the author's vast experience as a teacher at the London School of Tropical Medicine and at the Institute of Parasitology of Canada. The pictorial diagrams showing the situations of the parasites in their hosts and their life-histories are very illustrative and greatly enhances the usefulness of the book. In the chapter on "Immunity", the subject-matter has been admirably dealt with in a clear lucid manner. A new chapter has been added, dealing with the principles of the control of parasitic diseases in the light of the latest researches and field experience. Parasites found under all climatic conditions have been included with one exception which struck the reviewer prominently, the absence of the mention of *Schistosoma nasalis*, Rao, 1932, a severe pest of cattle in this part of the country, whose identity and pathogenesis have been firmly established.

It can be confidently stated that there is no other text-book on the subject in which the systematics of the parasites and details of the diseases caused by them and their treatment are so well blended to form a concise book. This is useful to the practitioner who may be interested only in the diseases, and also to others, who may like to have more information about the parasites causing the diseases. This book

can be specially recommended, as a model text-book for students of the Veterinary Colleges.

N. S. K. R.

Chemical Control of Insects. By T. F. West, J. Eliot Hardy and J. H. Ford. Frontiers of Science Series. (Chapman & Hall Ltd., London, W.C.2), 1951. Pp. 211. Figs. 44. Price 15 *sh.* net.

Modern entomological research requires a knowledge of many "border" sciences of which the chemistry of insecticides is one. While the book is mainly of interest to the toxicologist, it contains much which will be useful to the general entomological worker. The authors emphasise that a knowledge of the life-history and behaviour of the pest and the niche it fills, in its natural environment, is necessary for successful application of control methods. Each species of insects, therefore, presents as it were, a fresh problem for study. The various methods of pest control have been contrasted, with a knowledge of the action of the chemicals on the insect body. The chapter on fumigation gives useful details about factors influencing action of fumigants, and their properties and uses.

There are sixteen chapters, dealing with the early history, chemistry and insecticidal uses of insecticides, like the nicotine, rotenone, arsenical compounds, petroleum oils, tar oils, etc.; and also giving good account of repellents and attractants; and weed control. The chapter on chlorinated hydrocarbons, while giving the chemistry, agricultural and horticultural uses of D.D.T., B.H.C., chlordane and toxaphene, indicates the possibilities for new and even more potent synthetic compounds. Each chapter ends with a list of useful "References". The get-up of the book is also attractive. The book is very useful to the Economic Entomologist to get a picture of the chemistry of the insecticides with which he is connected professionally.

M. PUTTARUDRIAH.

Parasitic Animals. By Geoffrey Lapage. (Cambridge University Press). Pp. xxi+351. Price 21 s. net.

This is a handy volume on the ecto- and endo-parasites, excepting bacteria and fungi affecting man and his domestic animals. The author has taken considerable pains to describe concisely the life-history, method of contact and attachment and effects of parasitism on the host and the parasites, and the method of prevention. The subject has been well arranged and classified and treated in a manner intelligible even to the lay reader.

The author concludes in a philosophical vein and makes the reader ponder over the purpose and the force behind all these phenomena. These, we learn, are to be dealt with in a volume which is soon to follow.

K. P. MENON.

The Plant Glycosides, By R. J. McIlroy (Edward Arnold & Co., London), Pp. 138. Price 18 sh. net.

An up-to-date book on plant glycosides would certainly be a welcome addition to chemical literature, since earlier works were published some twenty years ago. The present small volume is claimed to contain only notes collected in connection with research work on natural products in the University College, Ibadon, Nigeria and is not intended to be more than an up-to-date summary for convenient reference by chemists, agriculturists and botanists. Its scope is therefore, naturally limited. Even so, the book contains a large number of errors that reduce its usefulness. The following represents a casual collection of such: p. 31—"The glucuronic component in baicalin is attached to position 6". Shibata and Hattori to whom reference is made, consider that it is probably in the 7-position. Actually its reactions resemble those of the 7-methyl ether of baicalein; p. 33.—Ononetin is "7-hydroxy-4'-methoxy iso-flavone"; p. 35.—Galangin is the "glycoside of 5:7-dihydroxy flavonol"; p. 35.—Gossypin is isolated from "Egyptian cotton flowers"; p. 39.—Citronetin is synthesised from "phloroglucinol and 6-methoxy cinnamaldehyde": p. 120.—Prunitrin is "7-methoxy-4':5-dihydroxy-iso-flavone".

Literature references are claimed to be complete upto October, 1950. Though this is roughly met, there are omissions of papers published earlier as the following examples will show: P. 31—For galuteolin only the very old reference of Barger and White is given. A later reference (*Chem. Abs.*, 1940) is not found. P. 35—A later reference to cannabiscitrin is not mentioned (*Proc. Ind. Acad. Sci.*, 1946, 23 A, p. 296). P. 40—The earlier work of Rangaswami, *et. al.*, in determining the position of sugar residue in naringin has been omitted (*Proc. Ind. Acad. Sci.*, 1939, Vol. 9), whereas the later repetition of the same in 1944 is mentioned. The actual synthesis of carthamidin and iso-carthamidin published in 1949 is not mentioned.

Thus, critical appraisal of past literature and correct expression seem to be seriously lacking.

The printing and get-up of the book are quite good, but the cost seems to be too high.

T. R. S.

The Invertebrates Acanthocephala, Aschelminthes and Entoprocta, Vol. III. By L. H. Hyman. (McGraw-Hill, New York), 1951. Pp. vi + 572. Price \$9.00.

The present volume on the invertebrates completes the consideration of the acelomates or the *Pseudoceolomata bilateria* as the author describes them. Like its predecessors, this work is also largely a compilation, of course, backed by the original researches of the author. As the author herself points out, there is not much work done on the Nematodes and had the author started making original investigations on this group, probably the publication of the present volume would have been indefinitely postponed, much to the disappointment of teachers and researchers. On the other hand, a much needed comprehensive original account on the Nematoda would have been available.

Each of the Chapters (XII, XIII and XIV) is devoted to a phylum. Comparing the Acanthocephala, system by system, with the Platyhelminia on the one hand, and Aschelminthes on the other, the author points out that its relation with the flatworms or the other cannot be definitely settled. It is, therefore, thought best to treat the phylum separately which show, however, affinities with them. Under Aschelminthes are included Rotifera, Gastrotricha, Kinorhyncha, Priapulida, Nematoda and Nemtomorpha which may appear at first as a heterogeneous assemblage of groups. One is amused to read that in the lowly rotifers, different species exhibit a predilection in choosing definite plants for attachment; even more interesting is the fact that particular locations on the axis of aquatic plants are selected by them! In describing the development of *Parascaris* (p. 225), no reference is made to the important phenomenon of 'chromatin diminution' though it is described separately on page 260. It is likely that students reading this description of Nematode embryology may lose sight of this very important fact. It is interesting to note that while *Parascaris* parasitises only the equidae, the unfortunate dog harbours at least twenty different genera in its body!

While under Acanthocephala and Entoprocta a useful account of the morphology and physiology of the phyla is given, such an account has obviously not been possible under the Aschelminthes.

The volume under review is not meant to be used as a text-book; but it is an excellent reference work and further is undoubtedly indispensable to the researcher in the field comprising the three phyla. The figures are either original or are specially redrawn for the book. The bibliography is very exhaustive. The author and the publishers deserve our gratitude.

L. S. R.

Report of the Proceedings of the Symposia on Fuels, Fats and Oils, and Research and Industry. (Published by the Central Laboratories for Scientific and Industrial Research, Hyderabad). 1951. Pp. vi + 206. Price Rs. 5.

As pointed out by Sir J. C. Ghosh in his inaugural address, the industrial prosperity of a State in this scientific age is intimately connected with a planned development of its resources through research. The speakers who took part in the symposia, therefore, did well in taking up only such topics as were related to the national needs and demands rather than dealing with too technical and theoretical discussions. Eighteen subjects were discussed at the meetings covering a wide range of topics such as briquetting and low temperature carbonisation of non-caking coal; fluidisation of coals; research in refractory materials; combustion of non-caking coals in a fuel bed; edible fat industries in India; castor oil and its gel; utilization of seed oils as surface-coating materials; keeping quality and nutritive value of fats, etc. In addition, an interesting section devoted to various aspects of application of research to industrial production is also included. This is a subject which, no doubt, needs particular attention from all those engaged in research if the country is to achieve economic independence speedily. The papers read at the meetings, and the discussions which followed, are now brought together in the form of a book which should provide valuable reference material. The printing and general arrangement of the material have been done with considerable care.

N. N. DASTUR.

Books Received

- Machine Shop Mathematics*, Second Edition. By Aaron Axelrod. (M/s. McGraw-Hill Books Inc.), 1951. Pp. ix + 359. Price \$ 3.60.
- Evolution*, Second Edition. By A. Franklin Shull. (M/s. McGraw-Hill Books Inc.), 1951. Pp. ix + 322. Price not given.

- A Text-Book of Physiology*. By P. L. Kolhhar. (Atma Ram & Sons, Delhi), 1951. Pp. ix + 316. Price Rs. 10.
- Photosynthesis and Related Processes*, Volume II, Photosynthetic Pigments, Kinetics of Photosynthesis. By Eugene I. Robinowitch. (M/s. Interscience Publishers), 1951. Pp. xi + 603-1,208. Price \$ 15.00.
- The Origin, Variation, Immunity and Breeding of Cultivated Plants* (Selected Writings of N. I. Vavilov). Translated by K. Starr Chester. (M/s. Chronica Botanica Co.), 1949-50. Pp. xviii + 364. Price \$ 7.50.
- Isotopes in Biochemistry*. Edited by J. N. Davidson and 4 others. (M/s. J. A. Churchill Ltd.), 1951. Pp. xv + 288. Price 27 sh. 6 d.
- Partial Differentiation*. By R. P. Gillespie. (M/s. Macmillan & Co.), 1951. Pp. viii + 105. Price 6 sh.
- Electrical Engineering Economics*, Second Edition, Vol. 2. By D. J. Bolton. (M/s. Chapman & Hall), 1951. Pp. xi + 307. Price 30 sh.
- Text-Book of Electrochemistry—II*. By Kortum and J. O. M. Boekris. (M/s. Elsevier Publishing Co.), 1951. Pp. xiii + 353-882. Price 70 sh.
- Facts, Files and Action in Business and Public Affairs*, Part I. By J. E. Holmstrom. (M/s. Chapman & Hall Ltd.), 1951. Pp. xvi + 449. Price 36 sh.
- Vitamins—A Digest of Current Knowledge*. By Leslie J. Harris. (M/s. J. A. Churchill Ltd.), 1951. Pp. xii + 244. Price 15 sh.
- A Text-Book of General Physiology*. By Hugh Dawson. (M/s. J. A. Churchill Ltd.), 1951. Pp. xiii + 659. Price 45 sh.
- Vacuum Physics* (A Symposium), *Journal of Scientific Instruments*, Supplement No. 1. Edited by H. R. Lang. (Institute of Physics), 1951. Pp. iii + 80 + viii. Price 15 sh.
- Advances in Enzymology*, Volume 12. Edited by F. F. Nord. (M/s. Interscience Publishers), 1951. Pp. ix + 570. Price \$ 9.75.
- Pharmacopœia Internationalis Editio Prima*, Volume I (International Pharmacopœia, First Edition, Volume I), W.H.O. Supplement 2, 1951. Pp. xviii + 406. Price 35 sh. or \$ 5.00.
- Management and Conservation of Vegetation in Africa* (Revised Bulletin, No. 41). (Commonwealth Agricultural Bureaux, Farnham Royal Bucks, England), 1951. Pp. 97. Price 10 sh. 6 d.
- Optical Instruments—Proceedings of London Conference, 1950*. (M/s. Chapman & Hall), 1951. Pp. xv + 264. Price 42 sh.

SCIENCE NOTES AND NEWS

International Symposium on Desert Research

The Research Council of Israel in co-operation with UNESCO is planning to hold a symposium on Desert Research in Jerusalem in May, 1952. The symposium will be under five sections: Climate, Soil, Water, Energy and Biology. Many specialists have already agreed to participate in the programme.

Symposium on Utilization of Industrial Wastes

A symposium on Utilization of Industrial Wastes will be held under the auspices of the National Chemical Laboratory of India, Poona, on February 13, 1952, and the following days. Important problems of utilization of waste from various industries are expected to be discussed in all their aspects by leading industrialists and scientists in the country. Enquiries in this regard may be addressed to Dr. J. V. S. Ramanjaneyulu, National Chemical Laboratory, Poona 7.

Dr. T. J. Job

Dr. T. J. Job, Chief Research Officer, Central Inland Fisheries Research Station of Government of India at Barrackpore, has been appointed Assistant Regional Fisheries Officer for Asia and the Far East, with headquarters at Bangkok.

Dairy Science Abstracts

Dairy Science Abstracts, published by the Commonwealth Bureau of Dairy Science, Shinfield, Reading, England, will be appearing as a monthly instead of a quarterly publication beginning with Volume 14, No. 1 (January), 1952.

Application from Scientific Workers

Agreeing to the suggestion made by the Association of Scientific Workers of India, the Government of India have issued a notification to the effect that in future any qualified scientific worker employed under the Ministry of Finance, etc., will be allowed full opportunities to apply for posts advertised by Union or State Public Service Commissions or other bodies for which they are qualified, provided their services can be spared without detriment to the work they are engaged on.

Raptakos Awards for Medical Research

Raptakos Medical Research Board Fellowships for the year 1952 have been awarded to the following candidates for research work in subjects mentioned against their respective names:

- (1) Mr. D. V. Rege, University Department of Chemical Technology, Bombay. *Role of Folic Acid and Vitamin B₁₂ in Nucleic Acid Metabolism.*
- (2) Miss Vatsala N. Thakur, Tata Memorial Hospital, Bombay: *Isolation of Carcinogenic Substances from Tobaccos used for Chewing in India.*
- (3) Mr. M. Bhimasena Rao, Indian Dairy Research Institute, Bangalore: *Milk Diets in Relation to Infantile Cirrhosis.*
- (4) Dr. K. Gopalachari, Government General Hospital, Madras: *Hypertension.*

Bose Research Institute

The Thirty-fourth anniversary of the Bose Research Institute was celebrated on the 30th November, 1951, when Prof. P. C. Mahalanobis, F.R.S., Statistical Adviser to the Cabinet, gave the Thirteenth Acharya Jagadish Chandra Bose Memorial Lecture on "Statistical Methods in relation to National Development".

With reference to the work of the Institute, the Director, Dr. D. M. Bose, said that cosmic ray investigations are to begin shortly and that the cytological and mutagenic action of X-rays, ultraviolet rays, ultrasonic radiation, as well as of different chemical reagents is being pursued. The effect of penicillin in inhibiting the growth of soil organisms, producing cytological effects on plant cells have been studied. It has been found that while the normal period of transformation of tadpoles to frogs takes place in about three weeks, tadpoles kept for some time in a dilute penicillin solution and then transferred to their normal habitat in water have continued to grow and increase in size for six months without being transformed into frogs.

CORRECTION

Vol. 20 No. 10. Read *Cyperus Scariosus* for *Cyprus Scariosus* (p. 273), and *Stemphyllum Ilicis* for *Stemphyllium Ilicis* (p. 276).

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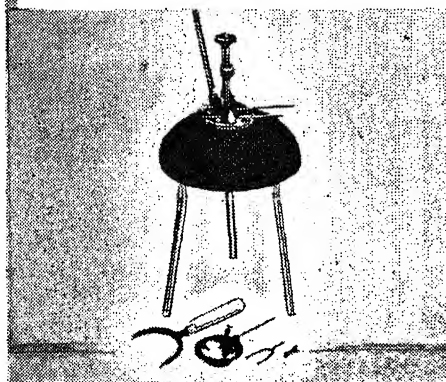
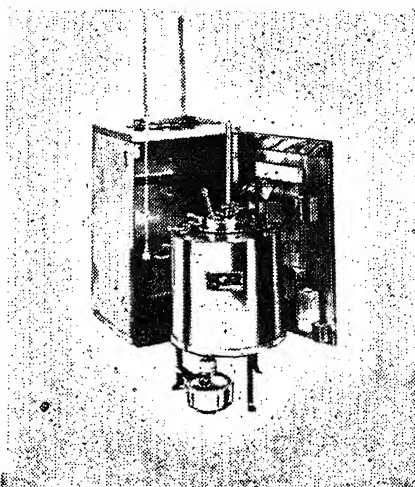
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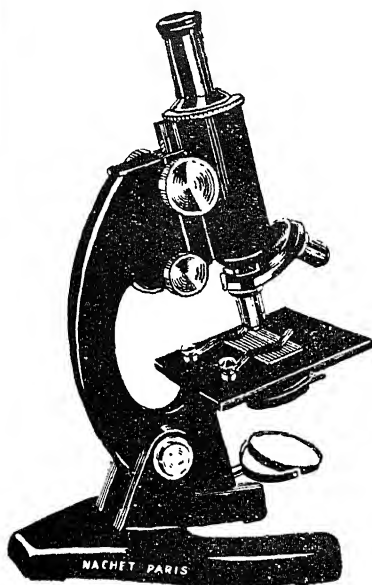
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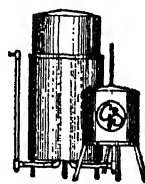
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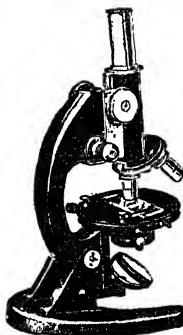
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